Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVI. NEW YORK, SATURDAY, DECEMBER 29, 1900. No. 26.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, ... President and General Manager.

CHICAGO OFFICE, ... 936 Monadnock Block.
PHILADELPHIA OFFICE, ... 929 Chestnut Street.

EUROPEAN OFFICE, ... A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, ... Editors.
T. R. TALTAVALL, ... Associate Editor.
CARL HERING, ... Special Contributor.

NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, ... per year, $3.00
Foreign Countries, within the Postal Union, ... 6.00
Single Copies, ...10
In requesting your address changed give OLD as well as new address.

Copyright, 1900, by the Electrical World and Engineer, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 29, 1900.

CONTENTS.

Editorial 983
Edison Moving Picture Litigation 986
Data as to Range of Prices 986
Boston Automobile Stages 986
The Trolley and Religion 986
The Electric Delivery Equipment of a Large New York Store, by Max E. Loewenthal, E.E. 987
Report on Electric Lighting Exhibits at the Paris Exposition 991
"Endless Chain" Trolley Tickets 993
Electric Power Transmission from Coal Fields at Colorado Springs, Colo. . . . 994
Automobile Stages in Mexico City 994
A Berthelot Prophecy 994
The Steam Turbine—II 995
Loss of Western Union Claim for Telephone Royalties 997
The Induction Motor—VIII., by B. A. Behrend (concluded) 998
Russian Telephone Concessions 1001
Telephone Conditions in the Rocky Mountain States 1001
Graphical Treatment of the Effect of Armature Current on Wave Form of Alternator, by F. G. Baum 1002
Electric Lights Along the Coast, by Geo. E. Walsh 1002
Current News and Notes 1003
LETTERS TO THE EDITORS:
Motor Starters, by H. Ward Leonard 1005
Use of Lighting Schedules, by Ann Arbor Electric Company and H. W. Frund 1005
The Design of Large Alternators, by Brown, Boveri & Company 1005
The Use of "Boosters" in Cable Laying, by Otto Schroeder 1006
Digest of Current Electrical Literature, Compiled by Carl Hering 1006
New Books 1010
Hot Wire Ammeters and Voltmeters 1011
"Light of Asia" Lamps 1011
DEPARTMENTS:
Financial Intelligence 1012
Commercial Intelligence 1013
General News 1014
Legal 1016
Obituary 1016
Personal 1016
Trade Notes 1016
Record of Electrical Patents 1017

ELECTRIC DELIVERY WAGONS.

A month or two ago we presented a remarkably exhaustive study by Mr. R. A. Fliess of the possibilities of electric delivery wagons in New York City, from the commercial standpoint. We are now able to supplement his able discussion of the subject based on actual tests, by an article in the present issue on the automobile delivery service of one of the large dry goods stores of New York City. Facilities for the preparation of the article have been kindly placed at our disposal enabling Mr. Loewenthal to tell the story of the work from its very inception; and while we should have welcomed fuller particulars as to cost of operation, this is a matter elucidated pretty fully in the Fliess series and in regard to which the element of time must now enter very extensively.

One or two points in connection with this work strike the observer. It will be noted, with surprise, that large as was the pre-existing electrical plant of the concern, it was found necessary to instal another unit to take care of the automobiles. Now the general theory is that the vehicles can be charged in the off hours of light load, but in this case the operation of the service has not lent its support to that plan. We still believe, however, that it should be feasible, although on the other hand a rapid growth in any such service would give a separate automobile charging set all it could do.

Another feature of interest is the manner in which the service was no sooner well established than it began to furnish a differentiation within itself, requiring a new type of delivery automobile for the purpose of transporting sales in bulk to sub-stations for local distribution. Each new condition thus developed or brought to notice requires a new form of vehicle, and the possibilities of development in the art are yet but barely touched. There is evidently much to study and much to learn, and meantime we must commend the enterprise of the concerns that make all this new work possible. We must confess that the use of horses for city work by industries representing all that is latest, most progressive and most advanced, appears to us very much of an anachronism.

ELECTRICAL TRANSMISSION FROM COAL MINES.

Much has been said but little has been done in the way of electric power transmission from coal mines. Even the interest which was manifested a few years ago in discussions of the possibilities of economy in this direction seems to have died out. Meanwhile, our Colorado friends have been doing some actual work in this direction, as shown elsewhere in this issue. In one case, that of the Cañon City plant, which is located near coal mines and transmits 24 miles at 20,000 volts to various mines in the Cripple Creek district, the conditions may be considered as rather unusual, or at least as usual only in mining districts. The freight rate for coal from Cañon City to Cripple Creek on the railroad, at the time the transmission plant started, was $3.50 per ton, to which should be added the cost of teaming from the railroad yards to the mines which might in some cases be as much more. Then, too, the difficulty of getting water for boilers at some of the mines was great.

At Colorado Springs, however, the conditions are very similar to those in many other places. The coal mines are comparatively near the city (3½ to 4 miles) and feed water is as available in the city as anywhere. Nevertheless, two large companies, after due considera-

tion, are building important plants at the coal fields, relying on the size of the generating units and the economy of handling coal direct from the mine to the boilers as a basis for under-bidding any steam plant located in Colorado Springs or Colorado City or at the points of power consumption. In one case 1400 horse-power is to be used by a reduction mill seven miles from the power station. Of course, the distances are short and freight, plus the cost of coal handling, is higher in proportion for a very short distance than for a long one. Nevertheless, these plants are enough to set engineers and capitalists to thinking again on transmission from coal mines, and it would not be strange, if, as the manager of one of these new plants predicts, a new pace were set for this class of work.

Multiplex Wireless Telegraphy.

A press cablegram reports that Prof. Slaby, of the Berlin Technische Hochschule, lectured last week in the presence of the German Emperor on multiplex wireless telegraphy, and in illustration performed successful experiments with a system he has devised for receiving simultaneously a number of messages from different sources. No details are given, and confirmation of this crowning development in wireless telegraphy will be awaited with the greatest interest. Assuming that the newspaper announcement is correct, the discovery upon which the system is based is apt to prove a capital one. Branly has shown that the coherer is almost equally sensitive if composed of fine filings, or of balls and disks of considerable size; consequently it is difficult to conceive of syntonized receivers corresponding to the receivers responding to different frequencies that have been used in multiplex harmonic telegraphy. A more probable supposition is the employment of means exterior to the receiver for separating effects due to different wave lengths, and directing each kind to a separate coherer. It may be recalled that Prof. Slaby had a very interesting article on wireless telegraphy in its earlier days in the *Century* magazine in which he described transmission for several miles, using a balloon.

Sun-Spots and Magnetic Disturbances.

An interesting letter from Prof. Oliver Lodge appears in the London *Electrician* for Dec. 7, and specifies a theory suggested by Prof. Fitzgerald to the effect that the undoubted disturbing influence of sun spots upon delicately suspended compass needles on the earth's surface may be due to cathode rays emitted by the sun spots. Assuming that cathode rays are emitted in this manner, they would travel with a high speed past the earth, and being streams of electrified particles, would correspond to an electric current sheet; or, as though an electric current jet was projected upon the earth from the sun spot. Prof. Fitzgerald, in a more recent letter, adds that a numerical estimate of the amount of matter so projected does not call for an unreasonable quantity.

The hypothesis is, therefore, that the magnetic storms accompanying sun spots are due to electric current streams dissymetrically enveloping the earth, accompanying a relatively minute amount of projected matter in the cathode ray state, carrying a relatively large amount of negative electric charge and moving at a high velocity. There seems to be a considerable evidence that at times when large spots on the sun come opposite to the earth, the magnetic observers report marked magnetic disturbances and occasionally these are so powerful as to interfere with the electric telegraph. The hypothesis introduces a virtual resemblance between a Crookes tube and the interstellar space between earth and sun, the sun spot being the virtual cathode and the earth a distinct target upon which the cathode rays may impinge.

Electrical Lighting Exhibits at Paris.

Elsewhere in this issue appears the official report of Mr. Carl Hering on that portion of the exhibits at the Paris Exhibition pertaining to the utilization of the electric current in electric lighting. Though in number of exhibits the United States ranked next to France, in quantity and arrangement the electrical showing of this country at the Exposition was in general not at all impressive, and this is reflected in the list of awards in the class covered in Mr. Hering's report. Had it not been for the efforts of Mr. F. E. Drake, United States Director of Machinery and Electricity, in gathering a collective exhibit, the American representation in Electricity Building would have ranked far below that of other industrial countries. Moreover, the perfunctory nature of some of the exhibits undoubtedly contributed to the paucity of American awards, and especially to the probable withholding in a number of instances of the highest distinction—the grand prix. On the other hand, awards were freely made to European exhibitors of American manufactures that it credited to this country, would decrease a disparity which, fortunately, will nowhere be accepted as indicative of the rank of the United States in the inventive and engineering branches of the electrical industry.

The "clou" of the electrical department of the exhibition was without doubt the Nernst lamp exhibit, concerning which Mr. Hering's report gives some interesting details. The electrical visitor to Paris could not avoid being impressed by this admirably arranged exhibit, consisting of scores of lamps grouped on the walls and ceilings of an artistic booth admirably adapted in conformation for the display. Though the temperature of the incandescent body is much higher than that of the incandescent carbon filament, the apparent absence of highly refrangible rays rendered the light soft and pleasing to the eye, thus disposing of an objection doubtless previously present in the minds of many. An experiment that never ceased to interest visitors was the "lighting" of a lamp with a match, and extinguishing it by blowing on the incandescent body with the breath. Mr. Hering refers to the ingenious means of overcoming by means of an iron wire resistance what at one time must have ranked as a serious difficulty to the practical operation of the electrolytic lamp—the maintenance of the current at a normal value. At the normal incandescence of electrolytic conductors slight changes in temperature correspond to comparatively large increments of conductivity. On the other hand, iron at its critical temperature with respect to magnetism has the opposite property of increasing rapidly in resistance with increase of temperature. Consequently by placing in series with the lamp an iron wire of proper size, the one effect automatically balances the other and thus leads to a stable condition of incandescence.

The report mentions the Bremer arc lamp and quotes the claims made for it as to efficiency, which claims appear to rest entirely upon the authority of a German professor. Though space had been reserved in Electricity Building, the lamp was not on exhibition there; and those who called at an address posted in the booth were not rewarded with a view of the lamp in action, if indeed they were permitted to see one at all. In fact, the Bremer lamp would have been looked upon as a myth were it not for the widely published descriptions of efficiency obtained in experiments on the lamp made by Prof. Wedding. So far as we can learn, the lamp has not yet entered into commercial use; nor do we know that any company has yet been organized for its manufacture, the exploitation of the lamp thus far being apparently confined to negotiating for the sale of the patents in various countries.

A most interesting part of the report is that in which an estimate is given of the number of incandescent lamps manufactured daily in the world. The output in the United States is given at about 100,000 daily and that of Europe at about 65,000 daily, or a total production for the world of about 165,000 lamps per day. At an average selling price of 15 cents per lamp, this would correspond to $25,750 per day, or, in round numbers, to $7,500,000 per year for this one item in electric lighting. Upon these figures a rough estimate may be made as to the income of the central stations of the world from incandescent lighting. Assuming 55 watts consumption for each lamp and 600 hours' life, each lamp corresponds to a consumption of 33 kilowatt-hours of energy. Assuming that one-half the total number of lamps are connected to central station mains, and that the average price of current is 10 cents per kilowatt-hour, a total consumption of about 2,750,000 kilowatt-hours per day is indicated, or a daily revenue of central stations from this source of $275,000, corresponding, on the present basis of calculation, to $82,500,000 per year. Including the income from arc lighting and motors, a roughly approximate figure for the total income of the central stations of the world is $125,000,000.

A MERIT OF ELECTRIC TRACTION.

Few papers have been more interesting among those read lately than that of Mr. Langdon before the English Institution of Electrical Engineers on the supersession of the steam by the electric locomotive, while the discussion provoked was of equal value and importance. It is not our intention here to take up the main question, but we desire to note the promptness with which the position taken by Mr. F. J. Sprague has been approved. That well-known engineer held in his remarks, as he has done on this side of the water, that what is involved is not a mere change from steam to electricity, but that the resort to electricity enables a company to give a quicker and more frequent schedule of service, and that this is likely to be the great inducement after all. While holding to the belief that the change, as change, is worth making, we may call attention to the fact that in almost every one of the many instances in which the trolley has "knocked out" the old steam service, its highly successful competition has been due to the quickness and frequency of its service. The passenger is not tied up to a time table, but gets a car almost at the moment he wants it and goes flying off to his destination, not in a big, lumbering train, but mayhap in a single car running twenty or thirty miles an hour, with very swift "stops" for casual fares. The very same system on a larger scale and more refined is what impends for much of the travel now handled by steam on main railroad lines, and Mr. Sprague was wise to make his point where and when he did.

TUNNELLED ARMATURES VERSUS SLOTTED ARMATURES.

It is curious to observe how the custom differs in different countries in regard to the practice of burying electric wires or bar conductors beneath the surface of the laminated armature in dynamo-electric machines. In this country it is the usual practice to produce slots in the armature and lay the conductors within the slots, the surface of the conductors in the slots being usually covered by a layer of insulating material. The advantage of this arrangement is that the self-induction of the armature conductors is reduced below that which tends to exist when they are completely enveloped by iron in tunnels, and practically all of the magnetic flux from the field magnets is compelled to pass beneath them. In other words, the magnetic linkage of the conductors with the field flux is greater, and the magnetic linkage with their own flux is less. On the other hand, it is necessary to support the conductors mechanically at their ends to resist the effects of centrifugal force.

In Europe, the tunnel winding is generally preferred, and the conductors are threaded through holes in the armature very close to the surface, it being considered that the mechanical advantages of support and protection are greater than the electromagnetic disadvantages of self-induction, or magnetic leakage thereby incurred. An intermediate practice is, however, in very general use, both here and abroad, of employing teeth that nearly meet over the grooves; or, as they may be regarded, tunnels, the roofs of which are cut open to the air so as to partly support and protect the buried conductors, and yet to prevent undue magnetic leakage through the tunnel roofs. The friends of the tunnel declare that with overhanging teeth the loss by magnetic leakage can be greater than with a tunnel having a thin roof, and that the mechanical protection afforded by the uncut tunnel is much greater. As usual in such cases, these seems to be a good deal to be said on both sides of the question, and no marked advantage seems to lie on either side. It is of interest to note in connection with this subject that the Wenstrom patent on the tunnel winding expires the present year.

SOURCES OF ELECTRICAL POWER.

A good deal of criticism and some little fun is being poked at the London *Spectator* because it has said broadly that in substituting electricity for steam power, England would so economize her fuel supply that her "coal would last practically for ever, because, except possibly for exportation to communities backward enough still to use steam, the only effective demand on it would be for the generation of electricity." The meaning of the well-known weekly is obvious, though the point might be more clearly stated. The *Spectator* is simply trying to popularize for average consumption Prof. S. P. Thompson's plan—and that of other able people, too—for burning coal at the pit's mouth and distributing thence the current generated in vast quantities by large units.

Such a plan as this should certainly result in large economies, not to mention other blessings in grimy Old England, and should defer the period when her coal beds shall reach their utter exhaustion. We have pointed to just such work now being carried out in Colorado, as described in detail in our pages this week. There the plants have been established right at the pit's mouth, and excellent results appear inevitable. It may be that England will not have to watch her coal supply so jealously ere long, as there are many indications that our coal will suit consumers heretofore dependent upon her; and this may at one and the same time cheapen her fuel, while extending the duration of the supply.

Considering what a wet place England is, the country is singularly ill supplied with water powers. There is water everywhere, but hardly a drop for driving. At some distant period when the coal has run out, this may prove a fact to her great detriment as a manufacturing nation, and to the advantage of such a country as Switzerland. On the other hand, it is not altogether unthinkable that by such a time wave motive power may be highly developed, in which case the tight little island would have things much her own way again, for the seas are ever restless around her coast; and as Douglas Jerrold groaned, Britannia rules the waves, but she does not rule them straight. In such an event, Switzerland, like the Transvaal, might have occasion to regret that it was not a sea "power." It may be noted in passing that in the English colonies this idea of transmission from steam plants is not unfamiliar. The Kalgoorlie plant in Western Australia is a case of the kind, and there the engineers have estimated net earnings of 16 per cent on an electrical plant costing about $1,000,000, the power to be used in mining operations.

Edison Moving Picture Litigation.

Few advances in the line of public amusement have been more rapid and successful than those in the production of moving or living pictures, and it was natural and inevitable that litigation should attend the growth of the industry. The matter is of great interest to electricians not only because of the apparatus required, but because so much of the work has been associated with the name of Mr. Edison. They will not be surprised to learn that last week the question of priority came up for argument in a suit of Mr. Edison against the American Mutoscope Company and "Continuous Performance" Keith in the United States Circuit Court for the Southern District of New York. The case was argued before Judge Wheeler, Messrs. F. P. Fish, R. N. Dyer and S. O. Edmonds appearing for the complainant, and T. B. Kerr and Parker W. Page for the defendants. The record of the evidence in the case is very volumnous. The patent in suit was No. 589,168, granted Aug. 31, 1897, to Mr. Edison, and its claims alleged to be infringed are Nos. 1, 2, 3 and 5. The three apparatus claims deal with the picture taking machine, viz., the single-lens camera, the single tape-like film and the rapid feed movement for feeding the film and turning on and off the light. The fifth claim embodies the unbroken translucent film with the pictures on it. In the brief and arguments, the case of the complainant is thus set forth:

The successful combination devised by Mr. Edison and illustrated and described in the patent in suit consists of a camera having a single lens, a shutter which opens and closes the aperture between the lens and the sensitive surface in rapid succession, and a single long tape-like film carrying the sensitive surface and fed with a rapid movement past the lens aperture. This combination involved all the essential characteristics.

By employing a single-lens camera the pictures were all taken from the same single point of view, and hence had the required quality. By making the movable part of the apparatus a light, tape-like film, the necessary high speed for securing the required large number of pictures per second could be produced without duplication of the film; and this film could be given the considerable length necessary for the continuous taking of pictures over an extended period of time without increasing the weight of the moving parts to a prohibitive extent. Besides this, the resulting picture strip possessed all the essential characteristics for successful use in an exhibiting apparatus. It permitted of the direct printing of photographs upon a similar film. And the strip thus produced had pictures of the proper quality, *i. e.*, taken from the same point of view, and arranged in a continuous straight line sequence throughout the length of the film and equi-distant from each other, thus permitting of its use in simple and practicable forms of exhibiting apparatus.

Nobody had produced a camera having these three essential characteristics; nobody had thought that that end could be secured by the simple combination of a single-lens camera and a single, rapidly-moving, tape-like film. That a single tape-like film could be moved with sufficient rapidity to secure the necessarily rapid succession of photographs from a single lens, having a fixed position with relation to the film, was a brilliant conception. It resulted in an epoch-making invention, which gave to the world the commercial living picture art.

From testimony which was given in the case it appears that Mr. Edison made this invention in the summer of 1889, but that due to the time required for the development of manufacturing processes and apparatus, and the difficulty he experienced in getting capitalists to take up the enterprise, it was not until the spring of 1894 that he put upon the market exhibiting machines employing the picture films made on his camera. His picture films and the exhibiting machines made by him held the market for upwards of two years without competition, when the great public success of his work made the commercial feature of the enterprise attractive to competitors, who then entered the field.

The general contention of the defense is that apparatus based on "the persistence of vision" had been known and familiar for a hundred years; and that claims 1, 2, 3 and 5 had been anticipated by prior patents and publications. The prior state of the art was most exhaustively ransacked and reviewed to demonstrate this point of view, the work of such men as Du Mont, Ducos, Le Prince and Woodbury, and the publications of Marcy, Levison and Bonta being particularly specified.

Data as to Range of Prices.

A comparison of prices in 1899 with those of preceding years in that great world's market, London, is made by Prof. A. Sauerbeck in a publication issued by the Royal Statistical Society of London, England, and just received by the Treasury Bureau of Statistics. This comparison, according to Prof. Sauerbeck's statement which precedes it, "shows the course of prices of 45 commodities during the last 20 years as compared with the standard period of 11 years, 1867-77." The statement of values is in the form of "index numbers" in which the average price during the period 1867-77 is taken as 100 and the relative price in the years named, from 1880 to 1899, is based thereon. The 45 articles considered are arranged in six great groups; vegetable food, animal food, sugar, coffee and tea; minerals, textiles and sundry materials. In vegetable food, the index number for the year 1880 was 89; for the year 1885, 68; for the year 1890 it was 65; in 1896 it reached its lowest point, 53, and in 1899 averaged for the year 60. In animal food the figure for 1880 was 101; for 1885, 88; for 1890, 82; in 1896 again the lowest point, 73, and in 1899, 79. Sugar, tea and coffee stood in 1880 at 88, in 1890 at 70, and reached their lowest average, 51, in 1898, and in 1899 stood at 53, though for coffee and tea, as shown in the discussion accompanying the tables, the 1899 figures were the lowest recorded in the tables. In minerals the index figure in 1880 was 79; in 1885, 66; in 1890, 80; in 1895 it reached its lowest point, 62, and in 1899 stood at 92, by far the highest point in the 20 years' period, 1880-99, under consideration. In textiles the index figure for 1880 was 81; for 1890, 66, and reached the lowest point in 1897 and 1898, when it stood in each year at 51, returning in 1899 to 58. In the list headed "sundry materials" the index figure for 1880 was 89; for 1885, 76; for 1890, 69, and reached its lowest point in 1897 when it stood at 62, and in 1899 returned to 65. Taking the grand total of the 45 articles considered in the various classes of vegetable food, animal food, sugar, coffee and tea, minerals, textiles and sundries, the index figure for 1880 was 88; for 1885, 72; for 1890, 72, and in 1896 it reached its lowest point, 61, returning in 1899 to 68.

Discussing the table from which the above figures are taken, Prof. Sauerbeck says: "The index number for all commodities was 68, against 64 in 1898, or 32 per cent below the standard period 1867-77, and 14 per cent below the 10 years 1878-87, but 3 per cent above the average of the last 10 years. As compared with 1898 the advance amounted to 4 points (or 6¼ per cent), while the rise on 1896, the lowest year on record, was as much as 7 points (or 11½ per cent). The rise was smaller than was probably expected by many observers."

Boston Automobile Stages.

About Dec. 30, 1900, the Boston Transit Company will place in operation a line of electric automobile omnibuses running over the following route: Starting at Massachusetts Avenue and Beacon Street, through Beacon to Arlington, to Boylston, to Tremont, to Scollay Square. The omnibuses to be placed in service on this line are of a temporary character only, and are to test the availability of the line. There has been a strong demand made upon the company by residents in the district through which the line will run, to have the service started. The vehicles will have a seating capacity for 10 passengers and will run at intervals of about 10 minutes over the route mentioned. The fare for the trip one way will be 10 cents. The company states that the whole undertaking for the present is in the nature of an experiment and the question as to whether or not the temporary vehicles shall be replaced by larger and more comfortable ones is dependent on the extent of the patronage which is given to the present vehicles as going to show how great a demand there is for public transportation of the kind in the neighborhood of the route covered.

The Trolley and Religion.

The following is from the *Christian City:* "The trolley is reproducing some of the conditions of early Methodism. It is scattering in new communities the best people we have in America—young people, thrifty people, educated people, aggressive people—where there are no churches. As our fathers went on horseback over mountain and plain to shepherd the shepherdless, so should we go by trolley wherever a new home is erected. Our Missionary Society and Church Extension Society should be made to see that the expansion that promises most to Methodism is not in the South, nor in the far West, nor yet in the Philippines, but in the suburbs of the cities of our own central home land."

The Electric Delivery Equipment of a Large New York Store.

BY MAX LOEWENTHAL, E. E.

THE presentation of experimental data is frequently resorted to as a necessary expedient to span the gulf which exists between theory and practice, but nothing will more conclusively settle a discussion or stamp upon an innovation the seal of approval than the publication of facts. Experimental data only too often portray ideal conditions which can seldom be attained in actual practice and are not convincing to the layman who is not in the habit of exercising the same acute care as that exercised by the experimenter. This has been found to be the case with the majority of persons interviewed by the writer in regard to the practicability of the electric automobile for light delivery service in New York City, most of those interviewed having had disappointing experiences with their equipments. The very convincing figures recently presented, however, in these columns by Mr. Robert A. Fliess, E. E., in his splendid series of articles entitled, "The Electric Automobile from a Commercial Point of View"; and his statement "when properly handled and cared for, the electric vehicle may be expected to accomplish successfully the work required of horses and wagons in light delivery service in the Borough of Manhattan, under ordinary commercial conditions," led the writer to investigate more carefully the methods employed by a firm successfully using a number of electric delivery wagons and to chronicle the results in these columns.

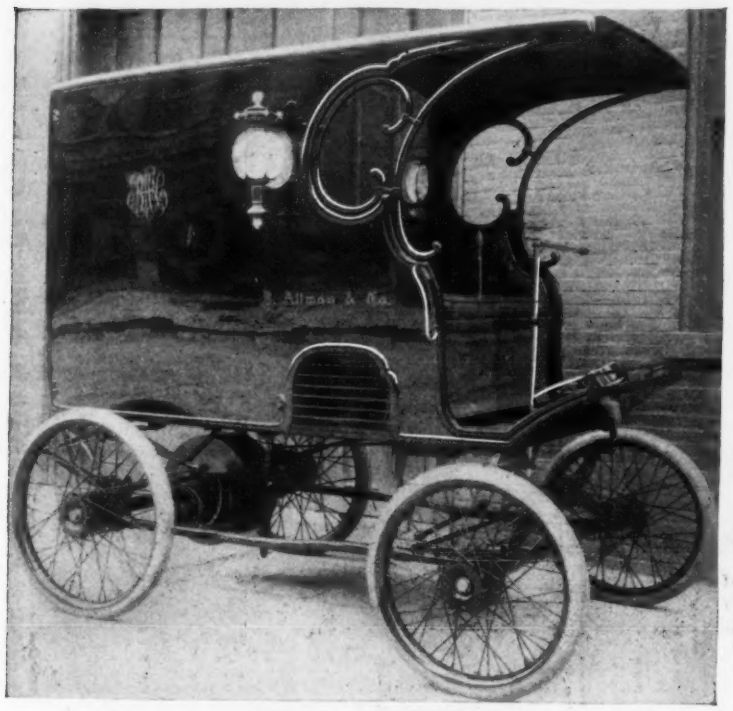


FIG. 1.—DELIVERY WAGON.

FIG. 2.—DELIVERY WAGON.

It will be admitted that the dry goods establishment of B. Altman & Company, New York, may be taken as a truly representative concern, not only because they have a large number of automobiles in service, but because they were pioneers in this direction; manifesting their faith in electric delivery wagons at a time when the subject was viewed with scepticism, and backing up their faith by continuously adding to their automobile equipment. Their course has plainly shown that the electric vehicles were not introduced merely as an advertising fad, but that it was "progress" which led to their introduction.

Considerable difficulty was experienced at first in finding motor and carriage manufacturers who would undertake the building of an experimental electric delivery wagon, as the conditions imposed were both novel and severe. It was finally decided, in 1897, to have the first vehicle built by Frederick R. Wood & Sons, New York, who have built all the subsequent vehicles for the company and to have the Riker Electric Motor Company, then located in Brooklyn, N. Y., furnish the electrical equipment. After a great deal of delay, this pioneer vehicle was finally completed, and was exhibited at the electrical exhibition in May, 1898, where it attracted considerable attention and was greatly admired for its handsome appearance.

The cab, or body of the vehicle, shown in Fig. 1, is richly ornamented, having the general appearance of the horse-drawn delivery wagons employed by the company. The rear wheels are 36 ins. in diameter and the front wheels 32 ins., equipped with pneumatic tires. A 2-hp motor is employed, which is geared to the rear axle, the motor and running gear, as well as band brake, being enclosed in a case. The weight of the body is equally supported on the four wheels, and the steering is done by means of the front wheels, which are pivoted at the ends of the axle and are carried in either direction by means of levers actuated by a vertical spindle with a handle attached, which is operated by the driver.

The controller is operated by the left hand and the reversing mechanism and brake lever by foot. In the steering handle is a button by means of which an electric bell, placed under the footboard, is sounded. On the footboard, in front of the driver, is placed a combination voltmeter and ammeter which indicates the condition of the battery for the guidance of the driver. The battery, consisting of 44 cells, of the M V 7 type, made by the Electric Storage Battery Company, and having a capacity of 90 ampere hours per cell, is placed under the driver's seat and part way back in the body, and may be withdrawn or inserted through side panels which are easily removed If the roads are reasonably level and in good condition, one charge will propel the vehicle 25 to 30 miles. The total weight is about 3000 lbs., of which 1000 lbs. is assigned to the battery.

A number of these vehicles were constructed, all of which are still in actual service, but as might be expected, shortcomings in pioneer design and construction were soon discovered which have been remedied in the types subsequently built.

Among the undesirable features should be mentioned the wire-spoked wheels. These were replaced by wheels having wooden spokes. Ball bearings, which caused trouble from the breakage of the balls, and were designed to eliminate friction as much as possible, and thus had considerable lost motion, were replaced by ordinary surface bearings. Solid rubber tires were substituted for pneumatic ones, which were frequently cut by the sharp corners of paving stones on account of the great weight of the vehicle. The differential gear constantly gave trouble by springing out of line, it being too light for the vehicle. In the later types the batteries are inserted from the back instead of from the side. Smaller wheels have been used and finally the reaches have been discarded on the newer designs. The now well-known "Wood pedestal gear" has been substituted; this arrangement will be explained in connection with the truck. While only a single motor was used on the first vehicle, being of the Riker make, two General Electric motors were placed on each of the next type of vehicles, and at present the company is using Westinghouse motors.

The next style of vehicle designed by the company and shown in Fig. 2 merits the name "delivery carriage" on account of of its resem-

blance to a pleasure vehicle, being provided with a door similar to that of a brougham. These doors, there being one on each side of the vehicle, are large enough to allow a man 6 feet high to stand erect within the wagon. Having the doors on the sides makes it more convenient for delivering packages. The doors can be opened only from within by a button on either side of the driver. A dummy handle is installed on each door on the outside. The Wood pedestal gear is used, making it possible to set the vehicle low, thereby taking away the "where is the horse" appearance. A band brake is provided on each rear wheel and is operated by a foot lever, while an equalizing lever makes it possible to check the vehicle within its own length without undue effort. The controller, which is installed under the seat entirely concealed from view, allows two speeds to the rear and four speeds ahead. The inside and outside lamps are of 10 candle-power each. The body within is all upholstered with the finest of morocco leather, and all the mountings are of brass. The battery consists of 40 cells, of the M V 9 type, manufactured by the Electric Storage Battery Company, having a capacity of 120 ampere-hours per cell. Operating the vehicle at a speed of 10 miles per hour it can be run over a distance of from 25 to 30 miles on one charge of the battery. The total weight of the wagon is about 4500 lbs. Three of these vehicles have been constructed up to the present time.

Still further, however, did this enterprising firm pursue its course in establishing the most complete and efficient individual delivery service in the country, perhaps in the world, and proving its firm belief in the economy and reliability of the electrically-propelled vehicle, by the building of a more pretentious and heavier self-propelled wagon than had ever been constructed for such a class of work. As quite a large proportion of the firm's goods has to be delivered above the Harlem River, it was found expedient to build a stable in the neighborhood of the Harlem Bridge, in 127th street, and distribute the parcels from that point. To transport the same to this uptown stable in large quantities and without loss of time, it was decided to construct an electrically-propelled truck. The outcome of this decision was the appearance, about two months ago, of the handsome vehicle, shown in Fig. 4, which makes it six-mile journey between the two stables twice each day. The truck is 14 ft in length, weighs 6000 lbs., complete, and has battery capacity sufficient to propel it from 20 to 30 miles on one charge. There are 44 cells of the Electric Storage Battery Company's type M V 11, each cell having a capacity of 160 ampere-hours, supported in a battery box constructed of channel iron shown at *A*, Fig. 3, and they may be reached through a trap door in the floor of the vehicle. The entire body is made of 3-in. channel steel. The vehicle is propelled by means of two 2-hp Westinghouse electric motors, geared to the rear axle in a ratio of 12 to 128, steel gears being used, shown at *B*. The pinion, however, is made of rawhide. Within this gear works expansion brake *C*, by means of which the vehicle can be stopped within half its own length when going at full speed. The plain "Collins" axle bearings are used and the solid rubber tires are 3½ ins. in diameter. The General Electric controller permits of four forward and two backward speeds.

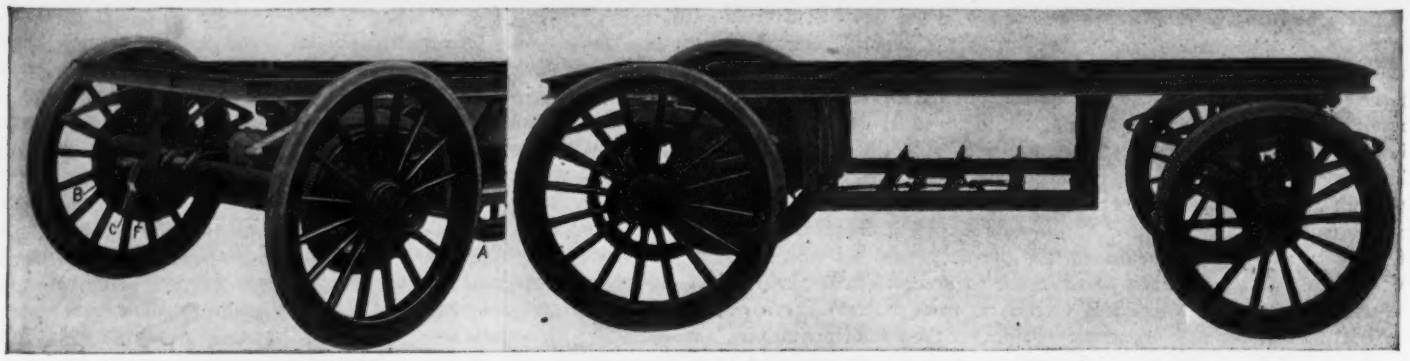


FIG. 3.—CONSTRUCTION DETAILS OF TRUCK FRAME.

Another very essential feature of the truck is the so-called pedestal gear *D*, which dispenses with any connection between the front and rear axles themselves and renders the four wheels as nearly independent of each other as practicable, thus securing greater flexibility in the running gear. This is of great practical importance in traveling over rough roads, where the front wheel on one side may be six inches higher than the wheel directly behind it, or even the wheel on the same axle, due to ruts and stones. Heretofore in automobiles the

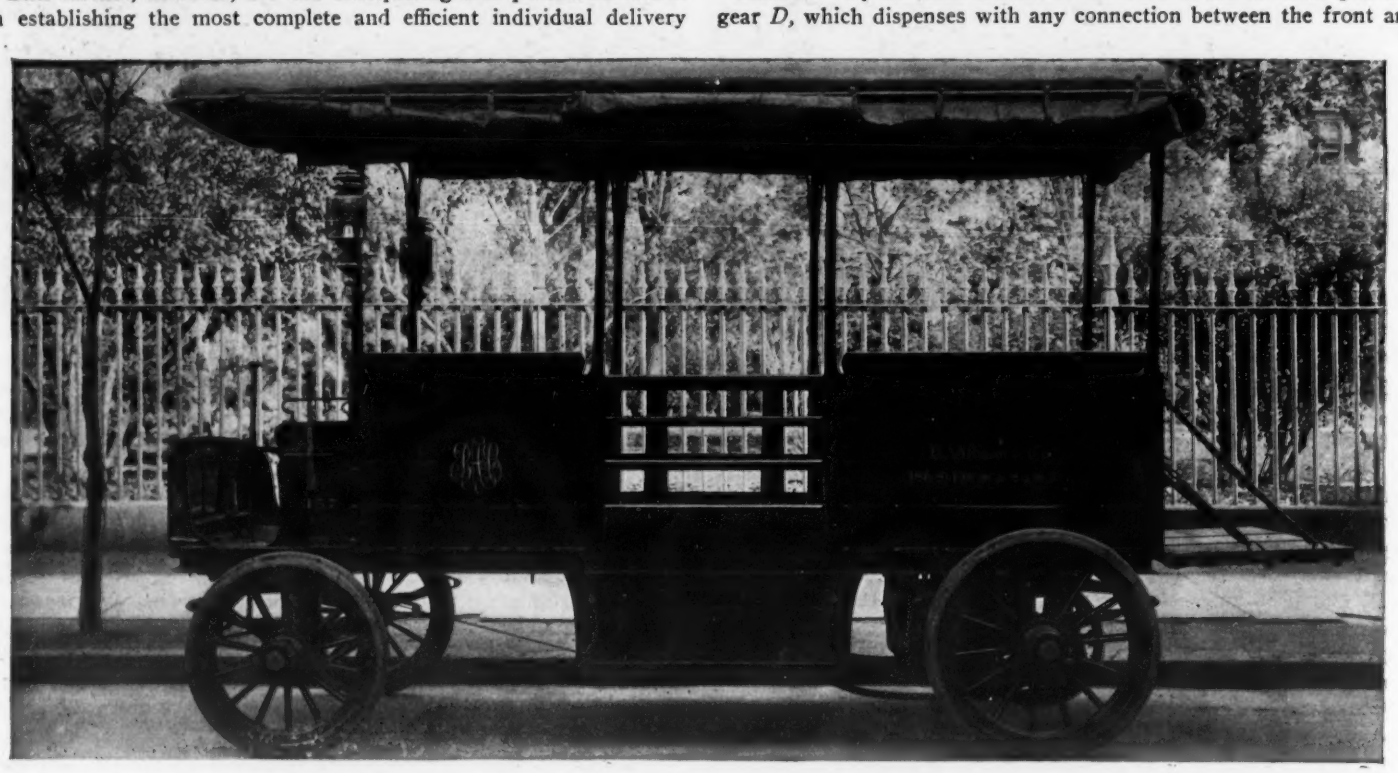


FIG. 4.—ELECTRIC DELIVERY TRUCK FOR DRY GOODS IN BULK.

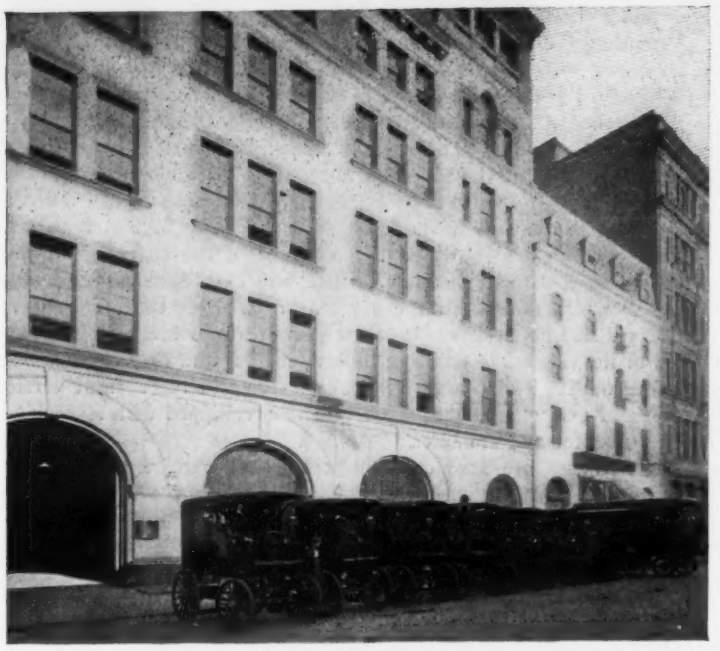


FIG. 5.—THE "STABLE."

firm carries out its undertakings we are not surprised to find a generating plant which from the standpoints of completeness, arrangement and cleanliness may be considered a model equipment.

In the boiler room are located four Babcock & Wilcox boilers, of 300 horse-power each, or a total of 1200 horse-power. They deliver steam at 110 lbs. pressure to three Ideal engines, of 150 horse-power each, direct connected to three General Electric 100-kw generators, one 300 horse-power Ball & Wood engine, direct connected to a 150-kw General Electric generator and one 350-hp Ball & Wood engine direct connected to a 216-kw General Electric generator. All these units are located in the engine room shown in Fig. 6, the floor of which is covered with Welsh tiles. It may be noted that in addition to these machines the engine room contains one 10-ton ice machine, manufactured by the Pennsylvania Iron Works, which cools the drinking water circulated throughout the store; also four Blake tandem compound duplex elevator pumps, four boiler feed pumps, which may also be used as house pumps, one 18x10x12 underwriters' fire pump and the hydraulic machinery furnishing power for 17 elevators, 12 of which are for passengers and 5 for freight, in addition to which there are 4 dummies.

The dynamos generate direct current at 120 volts, which is led to a remarkable switchboard by means of heavy cables. As will be seen in Fig. 7, the switchboard is extremely small (it being only 8 ft. square), in view of the fact that the generators supply current for 580 arc and 3000 incandescent lamps. The small number of switches on the board is explained by the fact that no distributing circuits proceed from the switchboard. Only the dynamo and street service

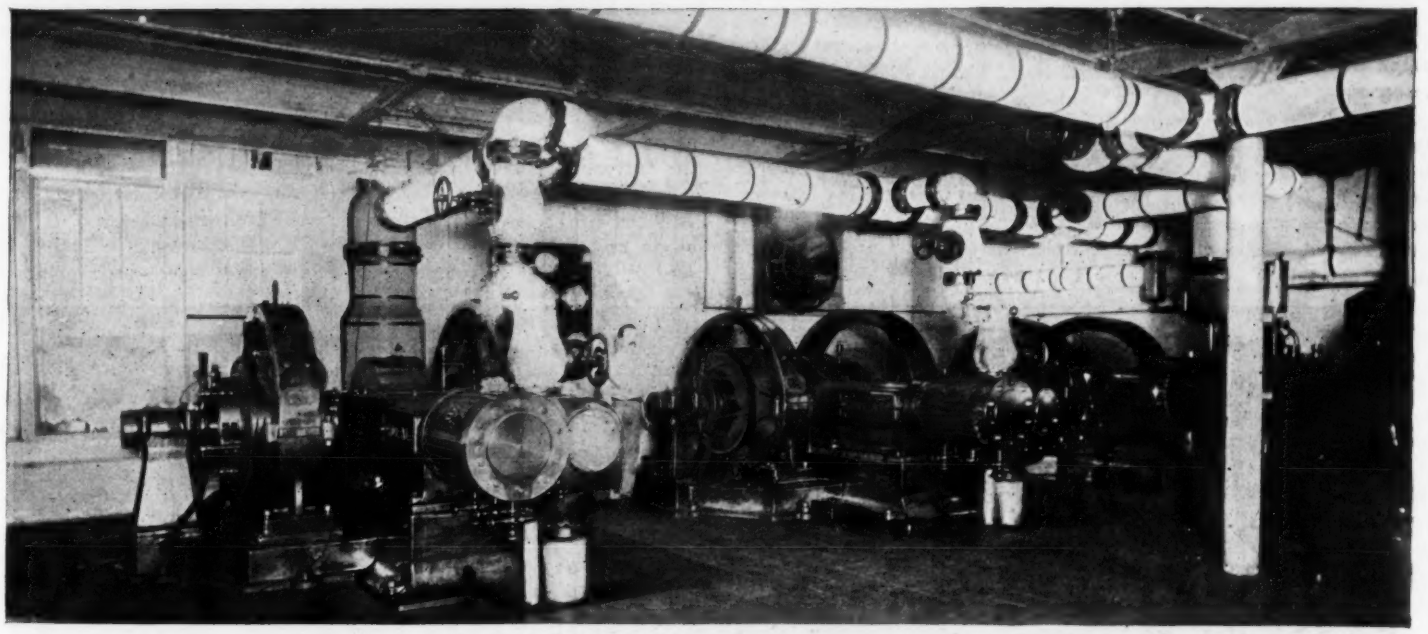


FIG. 6.—THE ENGINE AND DYNAMO ROOM.

"reach" type of running gear has been generally used in practice, the two axles being connected together, fore and aft, by reaches, or an equivalent framework. In some cases the reaches are attached to the axles by a flexible connection; but severe twisting strains are inevitably present when two reach-connected axles are obliged to move in different vertical planes. The arrangement shown consists of a pedestal *D*, which is rigidly connected to the framework *E* and supports the box *F*, which carries the axle, and is free to move up and down in a frame. This new form of connection has been patented by Lucius T. Gibbs, and, it is said, has given entire satisfaction. The truck is designed to run at a speed of from 7 to 8 miles per hour and will carry four persons in addition to a load of two tons.

Having now described the various types of vehicles which have been devised by and constructed for the firm, let us inspect the commodious quarters which have been provided for the storage of the vehicles and the up-to-date charging facilities. Before doing so, however, we will step into the basement of the imposing five-story red stone structure in West Eighteenth street, called the "stable" and shown partly in Fig. 5, where the engine and boiler rooms are located. They occupy nearly the entire floor, which measures 100x125 ft, and are connected with the main store building at the corner of Eighteenth street and Sixth avenue by means of a passage. Having by this time become accustomed to the thoroughness with which the

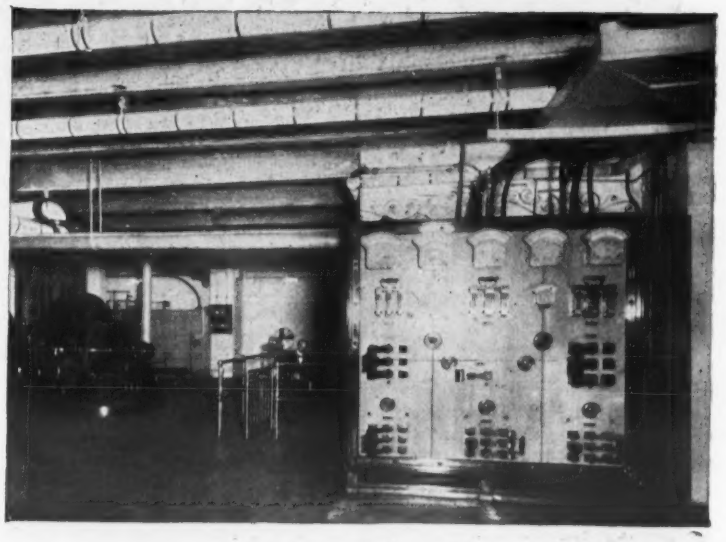


FIG. 7.—THE SWITCHBOARD.

mains are connected to the board, from which a duplicate set of cables is run to the four corners of the store, from which the lighting current is distributed. Each of these two feeders is capable of carrying 4000 amperes. The average consumption of current for a period of eight hours is about 1400 amperes, but between the hours of four and six in the afternoon the current rises to about 3200 amperes and at night the consumption is about 800 amperes, the light being needed by the store cleaners.

FIG. 8.—LINE OF ELECTRIC DELIVERY WAGONS STARTING.

This brief outline of the generating facilities has been given to bring out a somewhat disappointing fact in regard to the effect which the charging of the automobile batteries has on the operation and economy of the plant. The ideal condition for the most economical operation would be such that the charging is done during the hours of light load, and would not necessitate the installation of additional machinery. This very desirable condition, however, has not been realized in this instance, as the batteries require to be charged after the early afternoon trip, that is, between three and six in the afternoon, when, as stated above, the current consumption is already at its maximum. The batteries consume about 600 ampere hours which forced the firm to install the 216-kw unit, a step which, it is confidently hoped, will be warranted by the greater efficiency of the delivery service. The total engineering force numbers sixteen, namely a chief engineer, five assistants, four electricians, four firemen, one oiler and a cleaner.

Ascending the stairs we find ourselves in the charging room, which is level with the street, and is shown in Figs. 8 and 9. As will be seen, two bus-bars are run along the back partition which are connected with switches and rheostats and these in turn with the charging cord and attachment plugs. The latter, of which there are eight, are kept in compartments built above the floor, three of them being shown open in Fig. 9. In this figure the truck is shown in the act of leaving the station, the battery having just been charged. In Fig. 8 all the electric vehicles are shown in line in front of the charging outfits, ready to leave on their afternoon trips. While the batteries are being charged, which occurs after every trip, *i. e.*, three times each day, the driver and his assistant load the packages into the vehicle. The speed of the wagons is about 7½ miles per hour and they cover about 19 miles daily. The charging voltage is 120 and the current varies between 22 and 25 amperes. Each vehicle is equipped with a combination voltmeter and ammeter.

The batteries are frequently inspected, and repairs to them, or any other part of the electrical equipment, are made in the repair shops, located on the same floor. The responsibility for the satisfactory operation and maintenance of the automobile equipment rests with an engineer, who has had considerable experience with storage batteries and motor vehicles. The remainder of the building is utilized for the storage of about 150 vehicles and the stabling of the company's horses. In Fig. 5 are shown all the electric vehicles lined up in front of the stable.

The total number of electric vehicles owned by the firm is twelve, but the building of an additional number is contemplated. The total equipment consists of 121 new delivery wagons and 14 trucks. An operator and a delivery man are assigned to each vehicle and no difficulty has been experienced in training the men. They learn the operation of the vehicle very quickly and it is encouraging to be informed that no serious accidents have occurred since the automobiles have been put in service.

It is to be hoped, and may be expected, that this enterprising firm and the progressive manufacturers will continue to work in harmony and improve the self-propelled delivery vehicle, reducing its weight, insuring its reliability and increasing its mileage capacity. One thing, however, the above described installation has already shown, namely that when "properly handled and cared for," the electric automobile is a successful delivery vehicle.

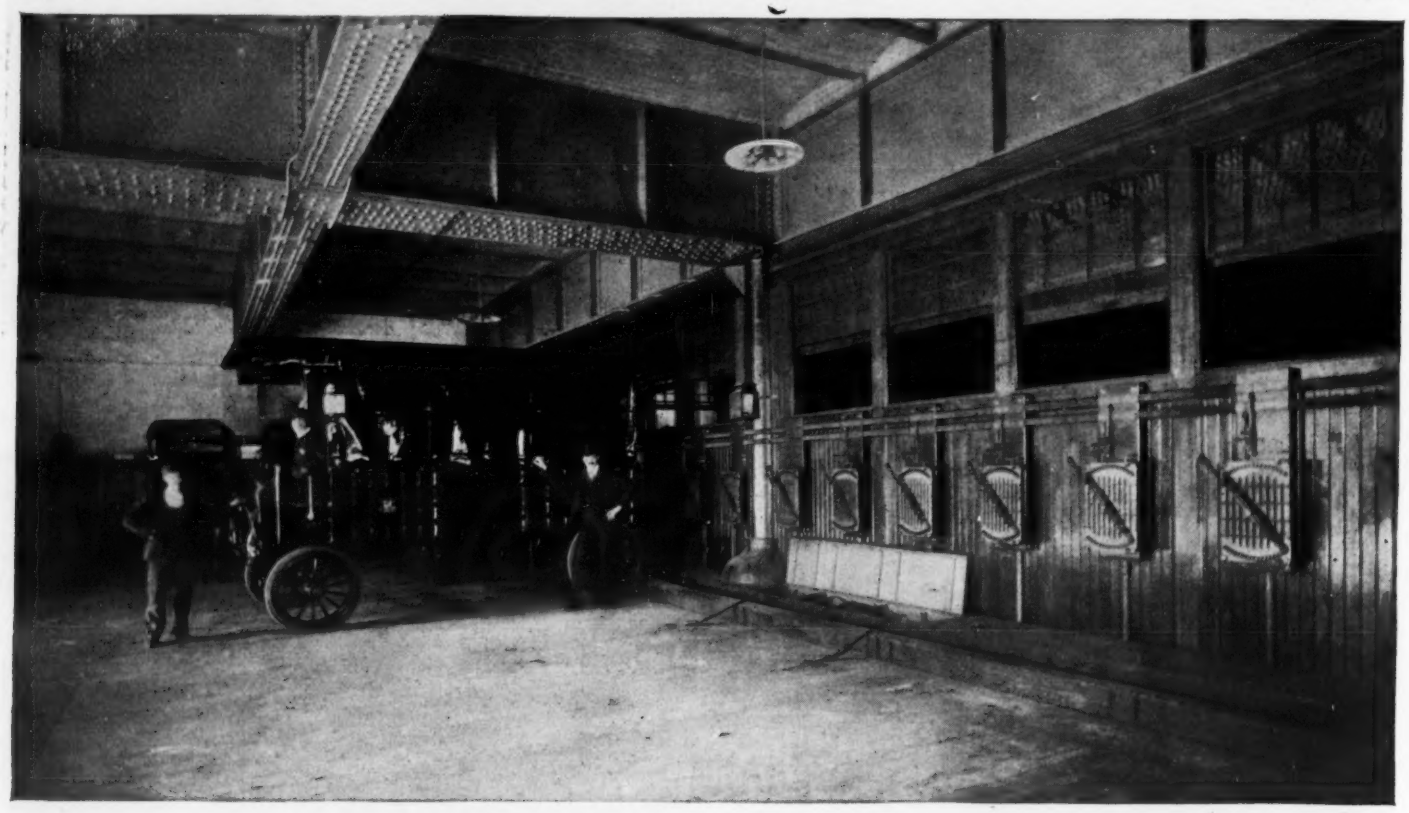


FIG. 9.—THE CHARGING ROOM, WITH TRUCK GOING OUT AFTER CHARGING.

In conclusion, the writer wishes to express his indebtedness to Messrs. M. Friedsam, C. H. Kay, William H. Eastment, and Messrs. Fred. R. Wood & Sons for the information which they cheerfully furnished.

Report on Electric Lighting Exhibits at the Paris Exposition.

WE print below an advance copy of the official report made to United States Commissioner-General Peck by Mr. Carl Hering in his capacity as United States Juror for Class 25 of exhibits at the Paris Exposition of 1900:

GENERAL AND STATISTICAL.

Class 25 of the exhibits at the Paris Exposition, comprised "Electric Lighting,' and included in the official classification: arc lamps and their carbons; incandescent lamps; installations; central stations; application to search-lights, navigation, war, and public works: safety and regulating devices; meters; photometry; apparatus for the distribution of light; fixtures and chandeliers.

The jury of this class consisted of 17 members; 8 of whom were French and 9 foreign; there were also four substitute members, 3 French and 1 foreign. All but one foreign member were present during most of the examinations and deliberations. The officers were Hippolyte Fontaine (France), president; Carl Hering (United States), vice-president; Paul Janet (France), reporter; Hippolyte Josse (France), secretary.

The number of exhibits in this class, in the official catalogue in the order of quantity, was as follows: France, 103; United States, 82; Germany, 15; Great Britain, 13; Switzerland, 8; Spain, 8; Hungary, 5; Mexico, 4; Italy, 3; Austria, 3; Russia, 2; Belgium, 1; other countries together, 9; total, 256. These, however, do not represent the actual number of exhibits, as some arrived too late to be entered, while others that were entered were not exhibited, and some were transferred to other classes. When corrected, the numbers were about as follows: France, 98; United States, 37; Great Britain, 13; Germany, 11; Switzerland, 9; Italy, 6; Austria, 5; Hungary, 4; Russia, 2; other countries together, 15; total, 200.

The number of exhibits, however, should not be considered as representing the relative importance of the participation of the respective countries, as some of the single exhibits were quite small and others very large. A comparison of the number of awards based on the number of exhibits, with the intention of showing the relative importance of the different countries, is therefore quite incorrect and is manifestly unjust to those nations having the larger number of exhibits.

The numbers of awards in this class were as follows: Grand prize, 18; gold medal, 46; silver medal, 37; bronze medal, 18; honorable mention, 2; nothing, about 53; hors concours (not subject to award on account of representation, direct or indirect, on the Jury), 26.

Of these, the following were awarded to exhibitors from the United States: Grand prize, 0; gold medal, 8 (or 17.4 per cent); silver medals, 8 (or 21.6 per cent); bronze, 9 (or 50 per cent); honorable mention, 0; nothing, 6 (or 11.3 per cent); hors concours, 4 (or 15.4 per cent).

NERNST LAMP.

The most prominent exhibit in this class, on account of its novelty and the great future claimed for it, was the Nernst lamp. Although the general principle of this new lamp had been announced several years ago, this was the first public exhibition of what was claimed to be the commercial form of the lamp. It was exhibited by the Allgemeine Elektricitäts Gesellschaft of Berlin, the owners of the patents, who had a pavilion lighted with about 300 of these lamps.

The lamp resembles in general appearance the ordinary incandescent electric lamp, except that the filament, instead of being carbon as usual, is made of magnesia together with the rare earths like zircon, thorium, etc. Such filaments must first be heated to about 700 degs. C. before they become conductors of the current; this may be done with a match or alcohol torch, or in the "automatic" lamps by a fine platinum wire 0.03 to 0.04 mm. in diameter, wound around a thin cylinder of porcelain placed near the filament; the current first passes through this "preheater" connected in parallel to the filament, and as soon as the latter becomes conducting, the current passes through it and a very small electromagnet in the base in series with it, which then cuts the preheater out of circuit. The filament is very much shorter than in the usual incandescent lamp and somewhat thicker. Unlike the carbon filament, it is not attacked by the air, and the bulbs are therefore open, which avoids all the defects and failures of the usual lamps which are due to imperfect vacua.

It may be used indiscriminately with either the direct or the alternating current. The lamps as now made are for 220 volts and of 25, 50, 100 and over, candle-power. A 25-cp lamp takes 0.185 amp., and a 50-cp lamp 0.37 amp., both at 220 volts. The economy is 1.5 watts per candle, which is about twice as good as that of the usual carbon incandescent lamps, therefore doubling the amount of light obtainable per horse-power. The light is whiter than that from the incandescent electric, the arc or the Welsbach gas lamp. The life of the filament is about 300 hours if the voltage does not exceed the normal; it is less affected by the inconstancy of the voltage than the ordinary lamp. The perishable parts, that is, the filament and the preheater, are made so that they can be easily replaced by the user, and they cost only about one-quarter of the price of the lamp, so that the cost per hour is no more than for the ordinary lamps, although the original cost of the lamp is greater. The lamps were not yet for sale, but the probable price, it was thought, would be about 50 cents, and that of the replaceable perishable parts 12 cents.

This lamp is not intended by the makers to take the place of the present incandescent lamp, probably because it is difficult to make it for candle-powers below 25 and voltages below 220. It is intended to take the place of the incandescent gas (Welsbach) lamp which is such a serious competitor of the present incandescent electric lamp; it is also intended to fill a want of some electric light between the usual incandescent lamp of 16 to 32 candle-power, and the arc lamp of 300-1000, and to take the place of the alternating-current arc lamp, and those for small currents of several amperes. The Nernst lamp should therefore not be considered as a successor to the incandescent carbon lamp, at least not at present, but rather as filling an important field of its own between that and the large arc lamp. Its points of advantage are the higher economy, the higher voltage and the replaceability of the perishable parts; its disadvantage is the fact that it must be preheated before it will light.

A feature of special interest from a technical standpoint is the use of a fine iron wire 0.019 mm. in diameter, connected in series with the filament, and placed in the bottom of the lamp. The resistance of the filament diminishes rapidly as the temperature increases, and a slight rise or fall of the voltage would therefore greatly affect the candle-power and the strain on the filament; the object of the iron wire is to overcome this. This wire is so proportioned that with about the normal current it is heated to that range of temperature 450 to 500 degs. C., at which iron has a very rapidly rising temperature characteristic, that is, its resistance increases very rapidly with an increase of temperature produced by an increase of current. Being in series with the filament the total resistance, which determines the current taken by the lamp, will be the sum of that of the filament and that of the iron wire, and as the former decreases with increase of temperature while the latter increases, this sum may be kept practically constant. This ingenious device is one of the principal improvements to which the present success is due. The iron resistance absorbs about 10 per cent of the voltage, but this is included in the above figure for the efficiency.

No lamps were for sale at the time of the exhibition, and it was therefore not yet in commercial use; but shortly after the close of the Exhibition the makers announced their readiness to place it on the market.

INCANDESCENT LAMPS.

Besides the Nernst lamps there was no important novelty or improvement shown in incandescent lamps other than the normal growth in the perfectioning of the lamps and in details.

The writer was told by the highest authority of the Allgemeine Elektricitäts Gesellschaft of Berlin that the 30,000 lamps made per day by that company contained no platinum. No further information could be obtained, nor could the nature of the substitute of the platinum wire be ascertained. The published descriptions of the products of that company contain no reference to it; but, on the contrary, stated that platinum is used where the wires pass through the glass. If this long looked for substitute for platinum has been found, and is actually in such extended use, it is an important improvement. The cost of the platinum in a lamp as made in this country is very small, notwithstanding that the price of the metal is about $180 per pound, but the daily output of lamps is so large that a saving in this item of cost would be worth striving for.

The Malignani thermo-chemical method of exhausting the last trace of air from the bulbs, was shown in operation. It is used by a French company, which claims that the largest manufacturers in the world (which are in the United States and Germany) also use it, but the latter statement is only partially correct, as the process has been superseded to some extent in those factories by mechanical pumping. The Malignani process consists essentially in temporarily attaching to the bulb a small tube containing a chemical like red phosphorus, for instance, which upon heating and upon subjecting the fila-

ment to double its normal voltage, absorbs the remaining traces of gases in the bulb after the mechanical exhaustion has been carried to about 1 mm. This chemical compound combines more especially with hydrogen and hydrocarbons, and the bulb is therefore filled with these before exhaustion. The vacuum is claimed to be perfect and the lamps therefore better.

The general practice in lamp making by the largest companies both here and abroad, seems to be to make the filament of a plastic solution of cellulose "squirted" through a hole into a thread which is then dried, carbonized and afterwards "treated" in hydrocarbons. The vacuum is produced mainly by mechanical pumps which have replaced the troublesome, expensive and slow mercury pumps. The Allgemeine Elektricitäts Gesellschaft of Berlin, which is no doubt the largest lamp manufacturer in Europe, makes 30,000 lamps per day at a selling price of about 12½ cents; 500 hands are employed in that factory. This is claimed by that company to be about half the total production in Europe, a statement which does not agree with those of other manufacturers. The daily production in Europe is probably greater than 60,000 lamps per day. One of the largest companies in France makes 12,000 per day; the total daily production in France is said to be about 32,000 per day, the lowest selling price being about 10 cents, but the average probably appreciably greater. The largest American company claims an output of 57,000 per day and that this is about half of the total daily production in the United States. Fifteen hundred men are employed and the average selling price is 17 cents. According to these figures the total production in the United States is somewhat less than double that in the whole of Europe; a safer estimate would be that the former is about 50 per cent greater than the latter.

The important direction of improvement started some years ago in making lamps of double the usual voltage, and therefore nearly half the current, is making progress, apparently more so abroad than here. It has been claimed that this is due to the consumers there being satisfied with a poorer quality of lamp than here; whether the latter is the case or not could not be determined by the writer; he noticed, however, that the lamps in the same room and even on the same chandelier were often of widely different brightness, indicating less care and less attention to economy than is exercised in this country. Another indication that the American lamps are better, is that England buys many of them in spite of the competition of the much cheaper German lamp.

The large German company makes high voltage lamps of 200 to 230 volts, and from 10 to 50 candle-power. The life of these at 3.6 watts per candle is claimed to be nearly the same as of those of half that voltage and 3.1 watts per candle. The economy is given as from 3.6 for 16 cp to 3.0 for 50-cp lamps at 230 volts and from 3.1 to 3.0 at 200 volts.

Very little impartial data could be obtained about lamps at the Exhibition and a certain amount of secrecy is guarded in their manufacture; it is, therefore, not possible to deduce very definite and reliable conclusions. This is all the more the case as the standard candles seem to be different here and abroad; the Hefner amylacetate lamp is the generally adopted standard abroad, while here the standard seems to be an undefined one handed down from previous years, and somewhat higher than the Hefner unit; a comparison of economies therefore appears to be less favorable to American lamps than it really is. Lamps are made by the largest manufacturers in this country up to 250 volts. Those of 200 volts, which are more satisfactory, are said to have an economy of 3.8 watts and are claimed to run about 750 hours before their loss of candle-power exceeds 20 per cent.

Considerable stress is now being laid abroad, on the advantages of forcing lamps at the expense of their life. The accompanying decrease in the total cost of the light, including both lamps and power, was pointed out by others besides the writer* nearly eight years ago. and is now being more generally recognized; a number of manufacturers are urging their customers to use the higher efficiency but shorter lived lamps. This is all the more important abroad where lamps are cheaper than here. The large German company claims a life of about 1000 hours for an economy of 3.1 watts per candle and about 300 hours for 2.6 watts. A large French company claims 1000 hours for 4.5-watt and 200 hours for 2.5-watt lamps.

A French exhibitor showed a system of using low volt lamps of about 20 volts, five in series on a 100-volt circuit, but each connected to corresponding points of the winding of a small, cheap, single-coil transformer or compensator, in parallel with the series of lamps, and placed near them, thus enabling one or more lamps to be out without affecting the others. An economy of 50 per cent was claimed on account of the higher efficiency of forced, low-volt lamps. This system would be of very limited application even if the claims were borne out when all of the costs and inconveniences are considered.

A French exhibitor winds a few turns of tinned wire in a groove near the base of the bulb, which enables the brass lamp base to be soldered onto the lamp.

The German companies are about to unite on a uniform standard lamp base and socket of the Edison screw type. It would be very desirable to not only do the same in this country, but to join with the other leading countries in adopting a standard international lamp base.

A French company exhibited a non-interchangeable lamp base of some interest, to prevent any but a lamp of a certain candle-power from being put into a given socket. It is of use more especially when consumers pay for the current by the number of lamps installed, instead of by meter. The contrivance consists of a bayonet jointed base with three instead of two dowel-pins; these are spaced differently around the base for lamps of different candle-powers.

Incandescent gas lamps known here as Welsbach lights, are becoming a serious competitor of the incandescent electric light. They are usually of much greater candle-power than the customary incandescent electric lamps, and ought therefore not to be compared directly with them. It is intended to meet this competition with the Nernst lamp which is to be of greater candle-power than the usual carbon incandescent electric lamp, and is much more efficient; it can also be used at higher voltages, thus reducing the cost of the conductors.

ARC LAMPS.

The only notable novelty in arc lamps, which may have an important future is the Bremer lamp. In this the carbons are mixed with 20 to 50 per cent of non-conducting metallic salts, like those containing calcium, silicon and magnesium, which, according to impartial and trustworthy measurements by Wedding* results in an economy as high as about 0.1 watt per mean hemispherical candle, which this authority claims is about three times as good as in the usual arc lamp. This is for continuous current; for alternating currents the efficiency was not as good. The consumption of carbon is about twice as great, but the specific consumption is no greater than before. The light is of a much more reddish and yellowish color than the bluish arc light, and is about 100 per cent more penetrating through misty air than the light from the usual arc, for which reason it is better adapted for search-lights and lighthouses. The white oxides formed are deposited on a shallow cone placed over the arc and form a very good reflector. The carbons are both at an angle as in the letter V with the arc at the lower ends. They are fed by their own weight, thus obviating the necessity of any mechanism except for starting the arc. The arc is 4 to 5 cm. long, which is very much longer than usual. If there are no attending disadvantages that more than counterbalances these advantages, there would seem to be a great future for this lamp.

There was a very large number of arc lamps exhibited, especially in the French section. In general the light from them is whiter and far more steady than is usual in this country, and the American lamps are not well thought of there for that reason. The difference seems to be due to the general type of regulating mechanism used here, which drops the upper carbon suddenly, while in France the upper carbon is allowed to descend only very gradually by means of a brake actuated by the regulating magnet, and acting on the periphery of a wheel driven by the weight of the carbon and its holder, at a much greater peripheral speed than the descending carbon. There are also other types of mechanism including the plain solenoid, but in general they all feed the carbons very gradually and regularly.

Arc lamps are almost always connected to constant potential circuits, at least on the Continent, and our more usual series system, which is scarcely known there, does not meet with favor, owing no doubt chiefly to the unsteadiness of the lights and the higher voltages of the circuits. With the exception of improvements in details in the foreign lamps, and the introduction in this country of the enclosed arc and some constant potential lamps, the status of the arc lamp is about the same as it was when the writer made a similar report to the United States Commissioner-General to the Universal Exposition of 1889 in Paris.†

In general the constant potential arc lamps are connected two in

*Trans. Amer. Inst., Elec. Eng., Vol. X, p. 65.

* *Elektrotechnische Zeitschrift*, July 5, 1900, p. 546.

† See that report, Vol. V, p. 52.

series together with a dead resistance, across the 110-volt mains. An improvement of importance shown in the French Section enabled three lamps to be connected in series without a dead resistance. This gives improved economy. In general it consists in using differential lamps; that is, those in which the regulation depends on both the current and the voltage. Many of the exhibitors also had alternating-current lamps, the mechanism of which was in general similar to those for continuous current, except that the iron cores have to be laminated. Some small, steadily-burning lamps in the French section, with as small a current as 2 amp., were also of interest, as they are rarely found in this country, notwithstanding their greatly increased economy over the incandescent lamp.

All the exhibits of the enclosed arc lamp were from this country, directly or indirectly. Notwithstanding the great progress made by this type of lamp in this country, it is not favorably received on the Continent, especially not in France, where it is objected to as being too unsteady and too blue in color, the French being accustomed to steadily burning, white arc lights. The chief advantages of these lamps, namely, the saving in attendance and carbons, are not considered there to balance their disadvantages.

The arc light carbons used in France are more generally cored and are, as a rule, of better quality than in this country. American carbons are not well thought of in France. The finer grade of carbons used there contribute to the greater steadiness and more even burning of the lamps found there.

ELECTROLIERS.

The exhibits of chandeliers for electric lights were almost entirely French and were, as a rule, very tasteful and beautiful, both in design and in workmanship. They were, however, often very badly adapted for concealed wiring, and their appearance was therefore often greatly marred by unsightly external wiring, which would not be tolerated in this country. Insulated pipe couplings for the tops of combination gas and electric chandeliers, so much used here, seem to be scarcely known there. Some of the decorative effects on chandeliers, made of inflammable materials close to incandescent lamps, although very beautiful, would not be allowed in this country on account of danger of fire.

A feature of interest to Americans in connection with the holophane globe exhibited in the United States Section, is that although the invention was French, and was the result of a vast amount of labor in making the calculations, the globes could not be made in France on account of the practical difficulties involved in their construction. It was not until an American company undertook the manufacture of them that this ingenious invention could be put on the market.

ACCESSORIES, SWITCHES, ETC.

Among the smaller accessories to electric lighting, except fuses, there seems to be little of special interest to Americans, as they appear to have been developed to a higher degree of perfection here than abroad, both in design and execution; many of those exhibited would not be permitted by the underwriters in this country. In general, the rules concerning safety against fire are not as strict as here, judging from some of the exhibits and some of the apparatus one finds installed there. There would appear to be a good market for American goods of this class abroad.

Regulating resistances, theatre dimmers, motor starting resistances and resistances of a like kind, seem also to be better developed here than abroad.

One of the large German companies uses fuses of silver in place of lead alloy, the reason being that for the same fusing current the amount of metal volatilized is least; the melting temperature is also lower than copper and they are more constant and reliable.

An interesting system of non-interchangeable fuses was also shown in the German Section, the object being to prevent a larger fuse from being substituted for a smaller one. The fuses are in porcelain plugs which screw into sockets to various depths, according to the capacity of the fuse. A plug containing a fuse which is too large could not be screwed in far enough to make both contacts. The system seems to be worked out well and could be introduced here to advantage.

SEARCH-LIGHTS.

There were some very fine exhibits of search-lights and light-house lights in both the French and the German Sections, but their description does not properly belong to this report. In general, the parabolic reflector seems to have superseded the Mangin, or reflecting lens type. The Schuckert Company grinds them by means of a machine which makes them perfect parabolas both inside and outside, and they utilize more of the light of the arc than the others, besides dispersing it to a less degree. The general practice is to make them of glass, but some made of metal were also shown, the advantages of which, in war, are evident. The largest projector was 1.5 metres in diameter, and was exhibited by the Schuckert Company, who first introduced these parabolic reflectors; the very large one at the World's Fair at Chicago was made by that company. Some of the search-lights exhibited were directed vertically and horizontally by electric motors, thus enabling them to be operated from a distance.

METERS.

While there were many exhibits of electric meters, it seems that the Thomson meter (American) is used most largely in Europe, except perhaps in Germany. The French company which manufactures it makes about 300 per day, which is a good indication of its popularity abroad. The modifications in it are in detail only. The same French company also makes the O'Keenan meter, which is a small, sensitive, cheap, continuous-current amp.-hour meter for small consumers; 11,000 of them are already in use. In principle it is like a d'Arsonval galvanometer or Weston measuring instrument, except that the coil can revolve on points, being provided with a four or six-part commutator and being wound in the form of a cylindrical cap covering the fixed core held between the poles of the permanent magnet. It is connected as a shunt to a fixed resistance in the main circuit, and the number of revolutions is registered. Its characteristic is almost exactly a straight line. Some idea of its sensitiveness is obtained from the fact that a 5-amp. meter starts with 0.03 amp, or less than 1 per cent. The current in the coil is then only 0.00025 amp. and the voltage only 0.0025, the power in it therefore less than 1 microwatt, and the torque is said to be then about the same as in the Thomson meter with 3.5 watts, which is over three million times as great. It is not yet practicable for large outputs. There would be a good field for such a meter in this country.

An interesting modification of the Thomson form of meter was shown in the German Section. The armature, instead of being of the Gramme type as usual, is wound like that of the original Thomson-Houston arc light machine, with three coils, two of which are always in series. The result is that the current passes through two of the coils in series instead of in parallel, as in the Gramme winding, and as the minimum diameter of the wire is limited by practical considerations, it is more thoroughly utilized by this series arrangement, or, in other words, the weight of wire required for a certain torque is very much less. This makes the armature much lighter in weight, with many important attending advantages. The commutator friction is also greatly reduced by this change. An impartial test showed that it had many excellent qualities.

The well-known Aron double pendulum meter was well exhibited and in numerous forms, one of which was for three-phase currents. It is used in Germany. Although well constructed and probably accurate, it is not likely that it would find much favor in this country.

"Endless Chain" Trolley Tickets.

The Co-operative Street Car Coupon Company has established agencies in Brooklyn to sell street and elevated railroad tickets at reduced rates. The scheme by which the concern operates is the old one of the endless chain. A person wishing to do business with the company buys of it or one of its agents a coupon for which he pays 25 cents. What happens then is thus explained in the company's official language: "Return this coupon to us with 75 cents, by mail or person, for which we will issue you a book of three coupons. Sell the three coupons for 25 cents each, thereby getting your 75 cents back. Each of those to whom you sell a coupon sends it to us, purchasing a book of three coupons for himself. When your three coupons have been sent in to us in this way, we will promptly notify you by mail, and you can call at our office and get twenty-five street car checks." It will be seen from this that the holder of the original coupon cannot get his twenty-five tickets for the outlay of 25 cents until the company has received $3.25. The street car tickets cost the company $1.25, thus leaving in the treasury a profit of $2. It would appear from this that anybody could afford to sell twenty-five tickets for 25 cents. It is expected, of course, that the three buyers of coupons from the original seller will dispose of their stock in the same way and thus keep the ball rolling.

Electric Power Transmission from Coal Fields at Colorado Springs, Colo.

SOME work interesting to the electrical engineer is going in at Colorado Springs at the present time. Although the plants in question are not yet in operation, a short outline of the work for which they are laid out will not be out of place.

The Colorado Springs Electric Company was recently formed to purchase the El Paso Electric Company, a corporation which was doing the principal electric light and power business of the city. This new company is under the general management of Henry Hine, well known to many readers of this paper as former manager of the Stanley Company, and who has as his general superintendent Geo. A. Taff, formerly of the same company. The new Colorado Springs Electric Company is going to do what many have talked about but few have done, namely, build a station at the coal fields and transmit power to the centre of the city, instead of shipping coal into the city and generating power there. Three and a half miles from the present plant in the heart of the city a station is nearing completion at a coal field, the output of which field is assured for as much coal as the company needs. The coal will be delivered in front of the boilers direct from the mine at the lowest possible cost. The output from this station will not only replace the steam engines at the present station, but will also be used to furnish power to two large reduction works located just west of the city, the works being used to treat the ores shipped down from the Cripple Creek mining camp over the range west from Colorado Springs. The company has a power contract with these mills for a term of years and also a contract to furnish power to the street railway. Taken altogether it will be seen that this new coal mine station will play an important part in the affairs of the community and with its coming importance in view the management is taking every precaution it can devise to make the service from the station reliable.

The old steam boiler plant at the present down-town station will be utilized to do steam heating, as it is near to the entire business portion of the city. A notable contract has been made with "The Antlers," a new hotel now going up to replace one destroyed by fire. The contract covers not only the entire heating and lighting, but live steam is to be supplied for cooking so that there will not be a coal flame about the hotel anywhere, and a degree of cleanliness not otherwise possible in a soft coal country will be assured. The new station at the coal fields will have five 400-hp Aultman & Taylor, B. & W. type water-tube boilers, with room for four more. Excellent soft water is available. The generating units are two 1000-kw three-phase General Electric 60-cycle machines with 80 poles, and running 90 r. p. m., specially designed for good regulation on inductive load. They are to be driven by International Power Company George H. Corliss compound engines. Piping is being furnished by Crane & Company, the heaters are Goubert, and the pumps Cameron. Current will be generated at 6600 volts. The generators are among the largest in diameter ever turned out, and are 21 ft. over the frame. Exciters will be separately driven by high speed engines. From the station two sets of three-phase lines lead in two directions. One transmission line of six wires will feed the sub-station at Colorado Springs in the old steam plant 3½ miles away, while the other six wires run 7 miles to a large reduction mill. A line 3½ miles long will also join the sub-station and mills, so that there will be a triangle of transmission lines, and in case of a breakage on one line feeding can be done over the other two sides of the triangle. At one reduction mill 1400 horse-power in motors and at another 600 horse-power in motors are contracted for. Some of the largest motors will be self-starting synchronous with exciters separately driven by induction motors. It is expected that these motors will improve the power factor of the circuits very much and help compensate for the lag caused by the numerous induction motors. Distribution for lighting will be made at 2000 volts and in stepping down change will be made from three-phase to two-phase. The street railway and power load will probably be run from 500-volt generators driven by synchronous motors, these motors being used because of their good regulation and for the other reasons just given, though it is possible that with the heating that is to be done from the old station it may be found economical to run a large Corliss engine already there on the railway load.

The lines for incandescent service, as well as prices, have been undergoing a general overhauling since Mr. Hine took charge. In one case in particular, 12 transformers replaced 127. Rates have been reduced from 20 cents to 12 cents.

The installation has many new features of interest which can best be described in detail when the plant is in operation. The extensive use of synchronous motors will be watched by those interested in polyphase transmission.

Another company making a bid for light and power business in Colorado Springs and also expecting to derive its power from a station located directly at the mine is the Citizens' Light, Heat & Power Company, of which E. E. Wade is manager. Its plant is being built at the Carlton coal mine on the Denver & Rio Grande Railroad, four miles north of town. It will generate current at 2300 volts two-phase and have no substations for lighting, but run directly to the consumers' transformers. For running 500-volt power circuits the two-phase current will be changed to three-phase at the power house and transmitted three-phase to rotary converters giving 500 volts on their secondaries. The power house will contain two 500-hp generators, two-phase Westinghouse generators running 100 r. p. m., direct connected to Allis Corliss engines. The engines will be simple, but with two cylinders per engine. Babcock & Wilcox water tube boilers with Worthington pumps and Cochrane feed water heaters are contracted for. The American underfeed stoker will be put under the boilers and coal will be dumped direct into the stokers as it comes from the mine. This company controls its own mines and figures coal will cost only 28 cents per ton at the boilers.

In general, Colorado Springs may be said to have entered into a new era of development. Its nearness to Cripple Creek and the fact that most of the Cripple Creek mines are owned by Colorado Springs men have combined to make its mining exchange second only to London in transactions. With the completion of the new short line of railroad to Cripple Creek, much Cripple Creek ore will come to the cheap power and water of Colorado Springs, as, in fact, much of it does now, with a roundabout railroad connection. The freight on coal up to Cripple Creek is enormous and water is scarce.

Automobile Stages in Mexico City.

The Mexican *Herald* of Dec. 4 makes the following remarks: "The new automobile omnibus service, between the National Palace and the Statue of Carlos IV. was subjected to a severe test on Saturday and Sunday last, when the streets of Plateros and San Francisco were crowded to their utmost capacity with people on foot and vehicles of all kinds. The new omnibuses must be given credit for having kept up a service of regular and frequent trips during all that portion of the day when vehicles were permitted on the streets named. Every omnibus was filled to its utmost capacity, and, in spite of the immense crowd, thousands of people were transported from one end of the route to the other; not only pleasure seekers who were viewing the illuminations, but people who wished to go to and from their homes. Not one accident took place during either of the two days, thus giving a practical demonstration that the automobile is the most easily managed of any public vehicle in use. The omnibusses presented a gay appearance draped with the national colors, and on Saturday night they were illuminated by red, white and green electric lamps, which added to the festive appearance of the streets. The extension of this excellent service through other important streets of the city may be expected when the sewerage repairs are finished and the new asphalt pavements are laid.

A Berthelot Prophecy.

M. Berthelot, the chief chemist of France during the last half century, the friend of Renan, the member-elect of the French Academy to represent science in that body, has given an opinion on practical things —on the development of machinery by the use of motive power. He declares frankly against steam, which, he says, is already growing obsolete, while electricity, which is only an intermediary between the material source of energy and its application, will always cost too much to become the motor force of common industrial life. For him, the future of motor-power belongs to petroleum and to gas. The steam engine will be relegated to museums, where other anthropological curiosities are collected, from the Stone Age down. M. Berthelot long since predicted that the time of chemical feeding of humanity is to come, when we shall carry beefsteaks and breadstuffs in our vest pockets, in the shape of convenient pellets supplying the necessary elements, carbons, azotes, phosphates, and the rest, to needy tissues; but this reform he does not announce for the twentieth century.

The Steam Turbine—II.

THE de Laval type of turbine is essentially of very high speed. The smaller sizes run about 30,000 r. p. m. and are geared down to about 3000; the largest sizes about 10,000 r. p. m. The peripheral speed of the wheel is usually from 600 to 1200 ft. per second. The reduction of speed is accomplished by means of a pair of helical spur gears with the angle of helix 45 degs.

These gears form by far the biggest part of the whole outfit. The remaining portions of these turbines have no remarkable features. The regulation is effected by means of a fly-wheel governor which is on the slower-running shaft and wire draws the steam at the admission.

Some tests of a 10-hp turbine were communicated to the A. S. M. E. in 1895, in which the turbine described had four nozzles of .138 ins. diameter and one of .157 ins. diameter of throat. The nozzles were two ins. long from throat to outlet. The speed of the turbine was 23,771 r. p. m., reduced by gearing to 2400; the economy at full load, non-condensing, was 47.8 lbs. per brake-hp. This economy is by no means bad when the small power of the outfit is considered.

In December, 1899, some tests were made in France, under the following conditions: 192 lbs. boiler pressure; with 69 degs. F. of superheat. The mean horse-power was 307.8; r. p. m., 772; consumption of steam, 13.92 lbs. per effective horse-power.

The first Parsons steam turbine and generator was built in 1884. It developed 10 horse-power at 18,000 r. p m. It ran for several years in Gateshead-on-Tyne, England, supplying current for the manufacture of incandescent lamps. It is now in the South Kensington Museum. It consisted of two groups of 15 turbines each, the steam entering between them and passing in opposite directions through each group.

Fig. 9 is a general longitudinal section through a Westinghouse-Parsons steam turbine. The steam enters at the governor valve and arrives at the chamber *A*, and passes out to the right through the turbine blades, eventually arriving at the exhaust chamber *B*. The blades are shown in Fig. 10, the steam passing first a set of stationary blades and impinging on the moving blades, driving them around and so on. The areas of the passages increase progressively in volume, corresponding with the expansion of the steam. They will, however, be described more fully later. On the left of the steam inlet are shown (Fig. 9) revolving balance pistons *C*, *C* and *C*, one corresponding to each of the cylinders in the turbine, which, according to size, may be 1, 2, 3 or 4 in number. The steam at *A* presses against the turbine and goes through doing work. It also presses in the reverse direction, but cannot pass the piston *C*; but at the same time the pressure, so far as the steam at *A* is concerned, is equal and opposite, so that the shaft is not subjected to any end thrust.

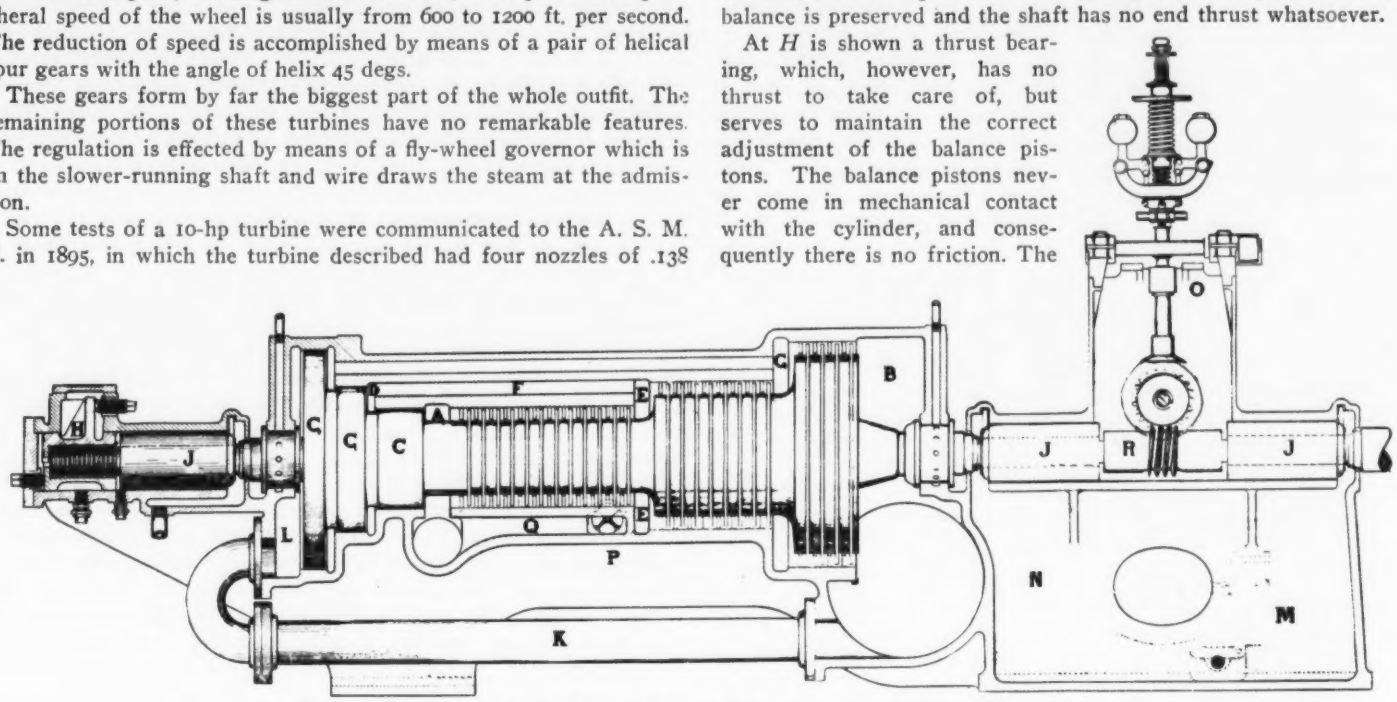


FIG. 9.—LONGITUDINAL SECTION THROUGH WESTINGHOUSE-PARSONS TURBINE.

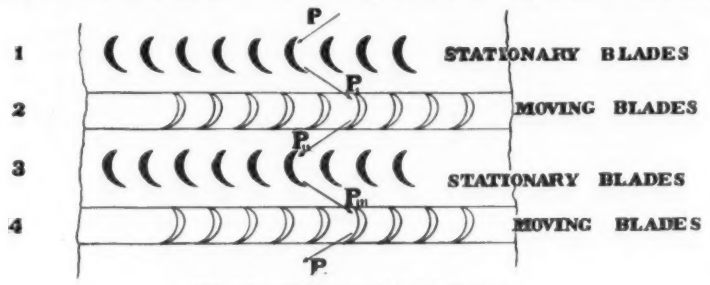


FIG. 10.—DIAGRAM OF THE BLADES.

The pressure *D* is equal to that at *E* by reason of the balance port *F*; so, similarly, as far as the steam pressure at *E* is concerned, there is no end thrust. This same fact also applies to *G*. The area of the balance pistons is so arranged that no matter what the load may be, or what the steam pressure or exhaust pressure may be, the correct balance is preserved and the shaft has no end thrust whatsoever.

At *H* is shown a thrust bearing, which, however, has no thrust to take care of, but serves to maintain the correct adjustment of the balance pistons. The balance pistons never come in mechanical contact with the cylinder, and consequently there is no friction. The thrust bearing has ample surface, and besides is subjected to forced lubrication and does not wear. The adjustments once made, always remain good.

There is obviously some leakage past the pistons, but it is found to be very small. Centrifugal force seems to have something to do with keeping down this leakage. The particles endeavoring to escape have to pass radially inwards in going through the small clearance. It is supposed then, that the rapidly revolving pistons have the effect of throwing outwards the particles with which they come in contact by reason of skin friction, so that the particles being slung outwards tend to oppose the escape of the particles inwards. This theory, however, is somewhat imaginary, but in view of the economy obtained the leakage cannot be very great.

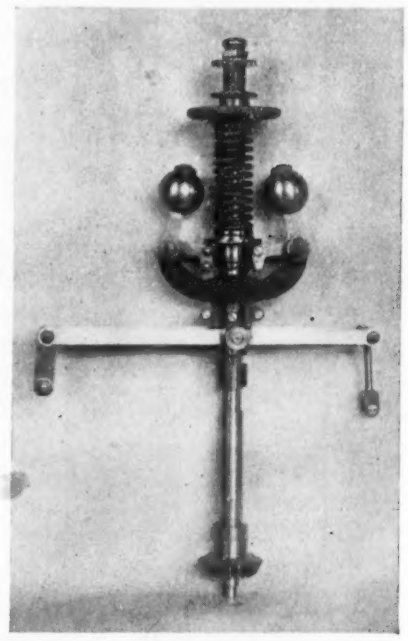


FIG. 11.—GOVERNOR.

At *K* is a pipe connecting the back of the balance pistons at *L* with the exhaust chamber, to ensure the pressure at this point being exactly the same as that of the exhaust. At *J* are shown the bearings, which are unique in construction. The bearing proper is a gun-metal sleeve, which is prevented from turning by a loose-fitting dowel. Outside of this are three concentric tubes having a small clearance between them. This clearance fills up with oil and permits a vibration of the inner shell, at the same time restraining the same. The shaft, therefore, revolves about its axis of gravity instead of the geometric axis, as would be the case were the bearing of everyday construction. The journal is thus permitted to run slightly eccentric, according as the shaft may be out of balance. This form of bearing in a very remarkable manner performs the functions of de Laval's slender flexible shaft. But in this case the shaft is built as rigidly as possible, so is not liable to crystallization, which would result in eventual

rupture. The bearings have ample surface, are continuously lubricated under pressure, and it has been found in practice that they do not wear. They are surrounded by an outer cast-iron sleeve, in which are fitted keys which may be shimmed up and permit any adjustment of the position of the shaft relative to the cylinder.

At *R*, (Fig. 9,) is shown a flexible coupling, by means of which the power of the turbine is transmitted. In small sizes the two shafts have a square cut on the ends, the coupling itself somewhat loosely fitting over these. In larger sizes it is generally a modification of this arrangement.

The governor gear and oil pumps generally receive their motion by means of a worm wheel, gearing into a worm cut on the outside of

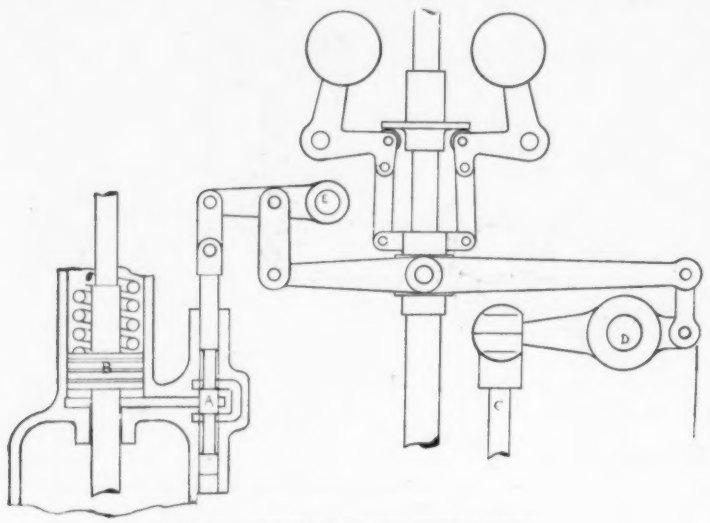


FIG. 12.—DIAGRAM OF GOVERNOR LEVERS.

the coupling. At *N* is an oil reservoir into which drains all the oil from the bearings. From there it runs into the pump *M* to be pumped up to the chamber *O*, where it forms a static head, which gives a continuous pressure of oil to the bearings. The pump is single acting, of the simplest possible construction that will not become deranged. The oil runs in by gravity, so that it is unlikely to fail to continue pumping.

A by-pass valve is provided, shown at *P*, which admits high pressure steam by means of port *Q* to the steam space *E*. By opening this valve, as much as 60 per cent. overload capacity may be obtained; and in the case of turbines operating condensing full load may obtained should the condenser be at any time inoperative, due to any cause, and the turbine allowed to exhaust into the atmosphere. Naturally the effect of opening the by-pass valve is to reduce the economy to an extent that will be seen later when discussing economy.

The glands consist of packing rings set in groves cut in the shaft. The rings press outward and remain stationary. Any form of frictionless packing necessarily leaks a little. In the case of the turbine

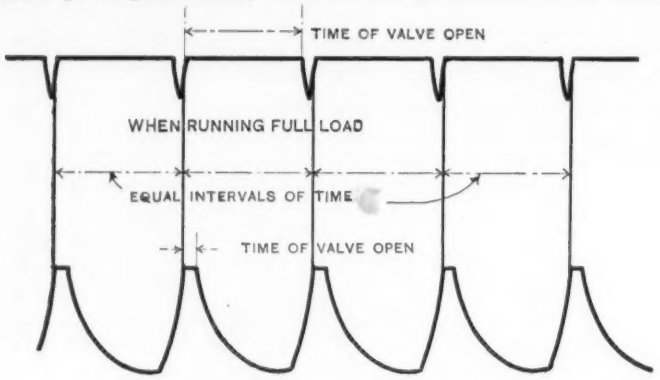


FIG. 13.—INDICATOR CARDS.

exhausting into a vacuum a little live steam is admitted between the rings by means of a small reducing valve, so that the leakage consists of a negligible quantity of live steam, instead of air, which would impair the vacuum.

In case of the turbine exhausting against anything above atmospheric pressure, a small ejector is provided, which drains the leakage steam from between the packing rings and allows it to drain through a suitable drain pipe instead of escaping into the engine room.

In all engines the governor is an important consideration. A fly-ball type of governor is made use of, as shown in Fig. 11, and has several features conducive to good regulation. The ball levers are swung on knife edges in lieu of pins. The governor works both ways; that is to say, the mid-position of the levers admits a full head of steam to the turbine. A movement from this in either direction tends to cut off the supply. This serves a useful purpose in the event of a very excessive load coming on the turbine, such as a short circuit, which has the effect of bringing down the speed more than the percentage variation permitted by the adjustment of the spring when the steam immediately becomes shut off. Again, in such an event as some of the governor-driving mechanism becoming broken and the governor balls slowing up independently of the turbine, the steam is shut off before any damage could take place.

The speed of the turbine may be varied within all the limits of the governor spring while the turbine is running. This is particularly useful in bringing alternations in synchronism and adjusting their differences of load when in multiple. This is accomplished by grasping the top knurled head when, by means of a ball bearing shown, the spring and tension nuts remain stationary. Any adjustment of the spring nuts may then be made, without in any way disturbing the running of the turbine, other than making the change that may be desired.

The arrangement of the governor levers is shown diagrammatically in Fig. 12. They are attached to a small relay valve *A*, which controls steam below the piston on *B*, which is directly connected to the main admission valve. The levers receive reciprocating motion at *C* from an eccentric, and use the governor clutch as a fulcrum, the points *D* and *E* being fixed. Continuous reciprocating motion is thus given to the relay valve. This is in turn transmitted to the admission valve. The function of the governor is to vary the plane of oscillation of the relay valve, which causes the admission valve to remain open for a longer or shorter period according to the position of the governor. The steam, therefore, is admitted to the turbine in puffs, which occur at constant intervals of time. The puffs are either of long or short duration, according to the load. At full load the puffs merge into an almost continuous blast.

If we were to attach an indicator to the steam space *A*, Fig. 8, and pull the drum around by hand, we would produce a series of cards similar to Fig. 13, the top card when running at full load, and the bottom when running at light load. This does not mean that in the latter case there is a more complete expansion of steam than in the former; it simply means that high-pressure steam is made use of at all loads. The complete expansion of the steam is taken care of independently in the blades.

The advantages of this intermittence are three-fold. The turbine is at all times using boiler pressure steam, no matter what the load may be. The admission valve is continuously in motion, and consequently gets no opportunity to get stuck.

The power to work the relay valve and overcome the inertia of the levers is transmitted through the governor clutch; hence the balls are moved in and out a very small amount at every oscillation of the

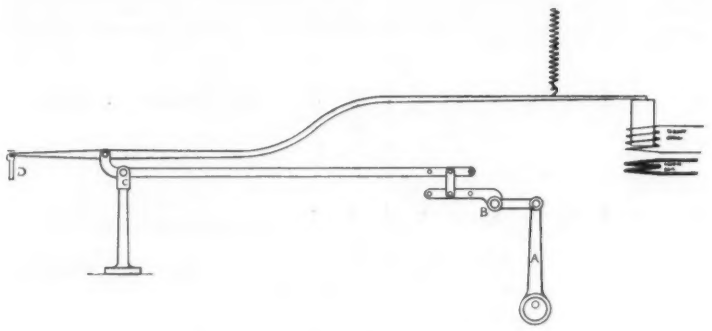


FIG. 14.—DIAGRAM OF LEVERS OF ELECTRICAL GOVERNOR.

levers, so that the governor levers in respect to their motion about their points of suspension are never at rest. Consequently, when a change of load comes the governor does not have to overcome the friction of rest, and is always ready to go to its new position. These features are particularly valuable. So long as a piece of mechanism is continuously working we at least know that it is in a condition to continue working and is not stuck.

There is absolutely no variation of angular velocity in the tur-

bine, which is necessarily present in reciprocating engines; hence the value of turbines for running alternators in multiple. This can be realized when we know a 500-hp turbine will run twenty minutes after the throttle has been closed. This, of course, speaks well for the low friction, but is principally due to the tremendous fly-wheel effect of the shaft. All the power is transmitted rotatively—there are substantially no reciprocating parts and no vibrations, and hence no costly foundations and no holding-down bolts are necessary.

Mr. Parsons made very successful use of an electrical governor which was attached to a relay valve working in exactly the same manner as just described. The arrangement of the levers is shown in Fig. 14. Reciprocating motion was given at *A*, points *B* and *C* being fixed. On the extreme right is hung, by means of a spring, a core working in a solenoid. When in operation the relay valve, D, oscillates continuously, and the core moves a very small amount by reason of its mass. At the same time it is ready to respond to any change of magnetic pull. One great feature of this governor is that the solenoids may be compounded so as to give constant e. m. f. at the terminals of the generator, the turbine running faster at full load than at light load to make up for copper losses in the armature. The governor may be further over-compounded to give any percentage rise, just the same as an over-compound generator.

In alternating current work the series coil is obviously separated from the shunt coil. This latter is in shunt with the exciter, and the series coil is usually placed above, having a separate laminated core. The adjustment of variations of e. m. f. between no load and full load may be conveniently made by changing the amount of iron in the series core.

The essential parts of the turbine are, of course, the blades and buckets. These are made of hard drawn material, and vary in size from ½ in. to 7 ins., according to where they may be used. Every row of these blades has passages of increased area, corresponding with the volume of the steam. This increase of volume is obtained by increasing the heights of the blades, and when these have reached the desired limit, the diameter of the turbine is increased and the steam permitted a higher velocity which enables the blades to recommence another progression.

Considering one barrel of the turbine, the fall of pressure, or to be more exact, the coefficients of expansion, are the same for every row.

Referring back to diagram, Fig. 10, the steam at pressure P in expanding through row (1) to pressure P_1 converts its energy into velocity and impinges upon the moving blades (row 2.) The steam then performs a second expansion in expanding through row (2), again converting its energy into velocity; but this time the energy of the efflux is to react upon the blades from which the steam issues. The same cycle is repeated in (3) and (4), and so on, until exhaust pressure is reached. The moving blades therefore receive motion from two causes—one due to the impact of steam striking them, the other to the reaction of the steam leaving them—in this respect this turbine being a combination of Bianca's wheel and Hero's engine.

Many people suppose that these blades wear under the action of steam. Experience shows that they do not. In the case, however, of a nozzle, such as has already been described, the result is very different, by reason of the tremendous velocity of the steam. The wear even then is not much when superheated steam is made use of, but with any entrained water the wear is quite rapid. In the Parsons turbine the velocities of steam never exceed 500 to 600 feet per second, and for the most part are considerably less than this.

The blades are secured in place by caulking. Experiments show that the force necessary to pull them out is as great as the elastic limit of the material of the blades themselves. The strain to which they are subjected in practice is about 1-40 of this amount.

Danger of the blades colliding sidewise is very remote. The smallest blades have ⅛-in. clearance sidewise, and the largest as much as ½ in. These dimensions are far beyond the limits of lateral motion permitted by the balance pistons. Of course, accidents *do* happen to the blades, but are generally attributable to carelessness, such as the machine having been taken apart, and in handling, some of the blades damaged, the machine being again assembled without having the damage repaired. The result of this, however, is less serious than would be expected. At the most, two or three rows are ripped out. The blades are very tough, and the first broken blades close up the passage in the succeeding guide blades and prevent the broken pieces passing and causing more damage.

In the event of such an accident the damaged blades may be removed and the machine put into service, when full power can be developed, but, of course, at a somewhat less efficiency, according to the number of rows missing. The blades may be permanently repaired in a very short time by chipping out the grooves and inserting new blades. This work can be done wherever the machine may be in service, as no special machine work is necessary. Such accidents, however, are among the improbabilities.

It may be interesting to record the actual pressure exerted on individual blades in a turbine. Take, for example, one of 300-kw capacity, to which special reference will be made. There are altogether 31,073 blades in the turbine, of which 16,095 are moving blades. The pressure that each of them exerts in revolving the shaft varies from .89 to 1.04 ounces.

The steam inlet is always provided with a steam strainer, which is intended to prevent foreign substances from getting into the turbine by means of the steam pipe. Generally such things as nuts, bolts, monkey-wrenches, etc., as have occasionally been known to come through a steam pipe, cause practically no damage, because they cannot pass the first row of guide blades. The greatest inconvenience of this nature is occasioned by small pieces of gasket choking up the guide blade passages, which appreciably brings down the power.

Loss of Western Union Claim for Telephone Royalties.

An important and long standing telephone litigation was lost on Dec. 21 in Boston by the Western Union Telegraph Company by Judge Colt's decision in the United States Circuit Court in its action against the National Bell Telephone Company, the predecessor of the American Bell Telephone Company. The case, which was started in 1883, was decided in favor of the defendant, the plaintiff's exceptions to the master's report being overruled, and the report of the master, the late Judge John Lowell, being sustained. The plaintiffs put their claim to royalties under the agreement as high as $12,000,000. It was mainly based upon 20 per cent of the profits received by the defendant from its exchange business and that percentage of certain stock which it received from various subordinate corporations which sprang up during the contract period from Nov. 10, 1879. Before the contract was made the plaintiffs and the defendant had been rivals and competitors in the telephone business, each claimed the right of exclusive control, and they were in expensive litigation. The contract secured to the defendant the telephone business of the country.

The defendant, which was then known as the National Bell Telephone Company, agreed to pay to the Western Union Telegraph Company 20 per cent of all rentals or royalties received from licenses for telephones in the United States. The Bell company issued licenses to sundry corporations, and received, in addition to the annual rental for telephones, 35 per cent of the capital stock of these concerns, and the plaintiffs claimed that this stock was "rentals or royalties" within the meaning of the contract, and that they were entitled to 20 per cent of the stock and the dividends on it.

The defendant contended that the "rentals or royalties" mentioned in the contract were the standard annual rentals, less commissions, and nothing more. The exchange business was not in it, the defendant contended, as it claimed the exclusive right under the contract to carry on the exchange business and to receive the profits or to license another corporation to carry it on, receiving from such license a share of the profits.

The case turned on the construction of the words "rentals or royalties" in the contract. The contract was to pay the plaintiffs 20 per cent of "all rentals and royalties actually received or rated as paid in accordance with the provisions of the contract from licenses or leases for speaking telephones."

This raised the underlying question of whether "rentals or royalties" included profits from the exchange business done by the defendant during the contract period, or referred only to standard annual rentals for telephones. The Court holds that the contract clearly shows that the accounting contemplated by this defendant to these plaintiffs for telephones leased in the United States was strictly confined to rental of telephones, and does not extend to profits derived from the employment of the telephone in various ways. Throughout the term of the contract the Western Union Company received royalties amounting annually to large sums, over $400,000 towards the close of the period.

The Induction Motor—VIII.

By B. A. BEHREND.

(*Concluded.*)

The Polar Diagrams of the General Alternating-Current Transformer.

IT is my aim in this contribution to present, in as simple and lucid a manner as possible, the general theory of the alternating-current transformer, taking also the resistance of the primary into account. The results of this consideration are, of course, well known, but as the road by which they can be reached is a very easy one, it may deserve some consideration. I shall make use in my treatment of the problem of the theorem of reciprocal vectors, known in kinematics and geometry as the theorem of inverse points, given in Dr. Frederick Bedell's book, "The Principles of the Transformer," and I will here make good a sin of omission, of which I became aware only when by chance glancing over the pages of Dr. Bedell's book in November, 1900. As early as 1893 Messrs. Bedell and Crehore gave not only the theoretical proof of the fact that the locus of the primary voltage in a transformer at constant current is a semi-circle,* but in his paper on "Transformer Diagrams Experimentally Determined," read at the Electrical Congress in Chicago, 1893, Dr. Bedell gave also the experimental proof for the constant-current transformer that the potential at its terminals can be represented by chords in a semi-circle.

DIAGRAM OF FLUXES AND MAGNETOMOTIVE FORCES.

The principle of the conservation of energy requires that the magnetomotive forces X_1 and X_2 of the primary and secondary of the transformer tend to magnetize the core in opposite directions. X_1 and X_2 may be considered to be magnetic cells producing, as it were, magnetomotive forces X_1 and X_2. The reluctance of the circuit common to both be R, the reluctance of the stray-fields that naturally form about X_1 and X_2, be ρ_1 and ρ_2. Let us call the flux flowing through X_1 and X_2, F, and the leakage-fluxes ϕ_1 and ϕ_2, respectively. We have then,

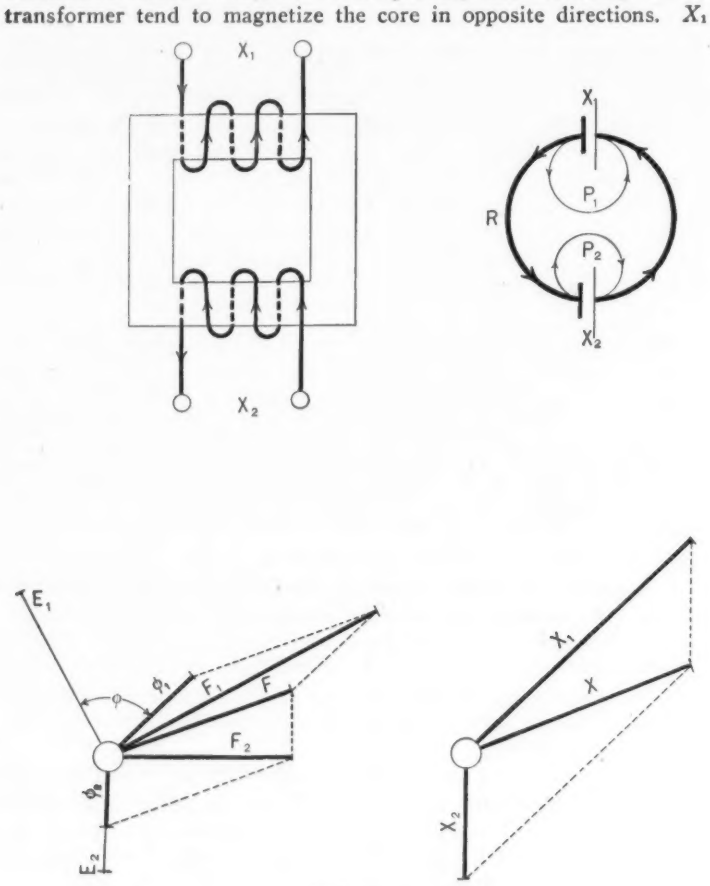


Fig. 40.

(1).....$X_1 = \phi_1 \rho_1$

(2).....$X_2 = \phi_2 \rho_2$

*See a series of ten articles on the "Theory of the Transformer," *Electrical World*, May, 1893, and later.

Treating X_1 and X_2 not as scalar quantities but as vectors, we may write,

(3).....$X_1 - X_2 = F \cdot R.$

The phase of the leakage-fields ϕ_1 and ϕ_2 is the same as that of the magnetomotive forces which produce them, hence they are in phase with the currents.

Let E_2, Fig. 40, represent the voltage at the terminals of a non-inductive resistance in the secondary of the transformer, then the current will be in phase with E_2. The magnetic field which is required to produce E_2 by its variation, is F_2, in quadrature with E_2. The lines of induction in phase with the secondary current, whose e. m. f. is in quadrature with the current, are represented by ϕ_2. We shall first treat the case in which these lines are all within the transformers, and next we shall deal with the case of an external inductance or capacity.

The flux F, as mentioned above, links together the primary and secondary coils. The vector-sum of ϕ_2 and F_2 is equal to F.

If we neglect for the moment the lag of phase between the magnetomotive force and the flux, then the magnetomotive force of the magnetizing current is in phase with the flux F. It may be represented by the vector X.

X must be the vector-difference between X_1 and X_2.

X_1, X_2, and X have real existence.

The leakage-flux ϕ_1 of the primary is in phase with the primary magnetomotive force X_1, and may be represented in the diagram by ϕ_1. The vector-sum of ϕ_1 and F is equal to the total primary flux F_1.

Let us now choose our scale for X, X_1 and X_2 so that X is equal to F; then, Fig. 41, $\overline{O\,A} = X_1$, and $\overline{O\,B} = X_2$.

THE DIAGRAM FOR THE CONSTANT-CURRENT TRANSFORMER.

Let us keep $\overline{O\,A} = X_1$ still and constant, then we see at a glance that the point G will move in the semi-circle O_1. $\overline{G\,C} = \phi_2$, is always a constant portion of $\overline{A\,C} = \overline{O\,B} = X_2$, because of equation (2).

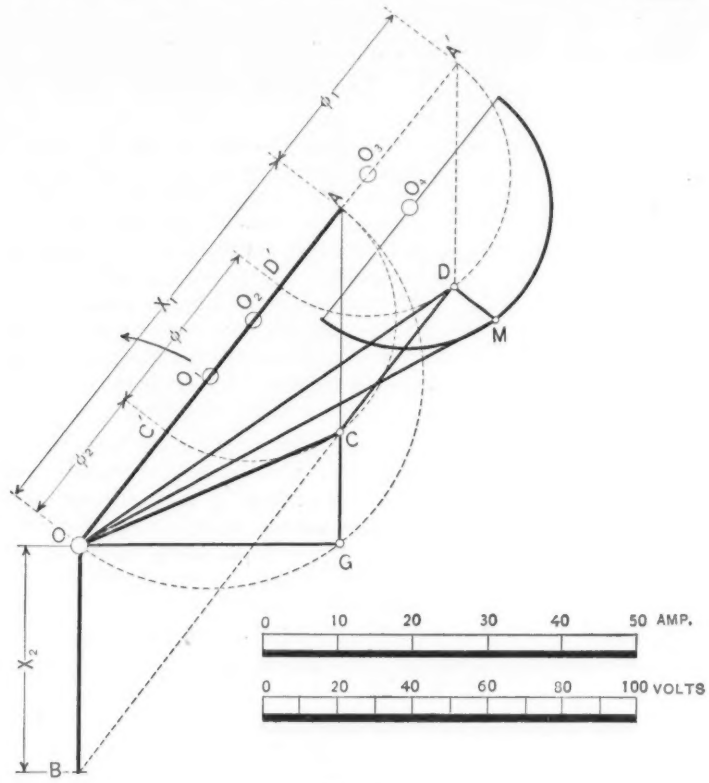


Fig. 41.

$\phi_2 = \dfrac{X_2}{\rho_2}$. A very useful way of defining ϕ_1 and ϕ_2 is that of A. Heyland, who writes,

$$\phi_2 = \tau_2 \cdot X_2.$$

Here τ_2 is obviously the magnetic conductivity or reluctivity of the leakage-path.

Similarly he writes,

$$\phi_1 = \tau_1 \cdot X_1.$$

According to the notation which I have used in the preceding

chapters, we define ϕ_1 and ϕ_2 by saying that $\overline{A\,G} = \frac{X_2}{v_2}$, and $\overline{O\,A'} = \frac{\overline{O\,A}}{v_1}$.

If G moves in the circle O_1, C, which divides $\overline{A\,G}$ in the ratio $\overline{A\,C} : \overline{A\,G} :: v_2 : 1$, also moves in a circle, which is determined by C' dividing $\overline{O\,A}$ in the ratio $\overline{A\,C'} : \overline{O\,A} :: v_2 : 1$.

It is just as simple to find the locus of the primary flux F_1, since, by our assumption, the primary current is constant, the leakage-field ϕ_1 is also constant. We have, therefore, only to transfer the semi-circle O_2 to O_3, $\overline{O_2\,O_3}$ being equal to ϕ_1, or, to put it differently, $\overline{O\,A} : \overline{O\,A'} :: v_1 : 1$.

The primary resistance can easily be taken into account as we may imagine that the drop caused by the ohmic resistance is equivalent to the e. m. f. produced by a magnetic field of constant magnitude, lagging behind the current by 90 degs. This field is represented by $\overline{D\,M}$.

The locus of the primary field is, therefore, the semi-circle O_4, $\overline{O_3\,O_4}$ being equal to $\overline{D\,M}$.

The potential at the terminals, necessary to drive a current proportional to X_1 through the transformer, is proportional to $\overline{O\,M}$.

From $\overline{O\,M}$, the potential at the terminals is calculated from the formula

$$100\ e = k \sim z\ F\ 10^{-6} \text{ volts},$$

in which k is generally equal to 2.22, if z is the number of conductors, and equal to 4.44, if z is the number of convolutions.

The position of the semi-circle can now easily be determined either by the use of complex imaginary numbers, or graphically, as I prefer.

The ratio $\overline{O\,D'} : \overline{A'\,D'}$ can be found at once. We have:

$$\overline{O\,D'} = \frac{X_1}{v_1} - \overline{A'\,D'}$$

$$\overline{A'\,D'} = X_1 \cdot v_2, \text{ hence}$$

$$\frac{\overline{O\,D'}}{\overline{A'\,D'}} = \frac{\frac{1}{v_1} - v_2}{v_2} = \frac{1}{v_1\ v_2} - 1$$

This constant ratio we call the leakage factor of the transformer, and denote it by σ.

$$(4) \ldots\ldots\ldots\ldots\ldots\ldots \sigma = \frac{1}{v_1\ v_2} - 1$$

To recapitulate: In a constant-current transformer whose secondary resistance is varied from naught to open-circuit, the terminal voltage varies in such a manner that the vector of the field to which it is proportional and with which it is in quadrature, has for its locus the semi-circle, determined by O_4 as centre. The position of this circle is perfectly defined if the primary resistance and the leakage factor are known.

THE CONSTANT-POTENTIAL TRANSFORMER.

If, in Fig. 41, we wanted to know what current would flow through the transformer at a certain difference in phase between $O\,M$ and $O\,A$, if $\overline{O\,M}$ were n-times as large as in the diagram, we should simply reason that, the counter e. m. f. being n-times as large, only $\frac{1}{n}$ times as much current could flow through the transformer. Hence, if we kept $\overline{O\,M}$ constant, varying only its phase relative to $\overline{O\,A}$, the current would vary in inverse proportion to the magnitude of the field-vectors. If we kept $\overline{O\,M}$ not only constant, but also in the same position, the locus of the vector $\overline{O\,A}$ would also be a semi-circle. This is a very fertile principle, and it was called by Dr. Bedell the method of reciprocal vectors.

Let, in Fig. 42, the semi-circle having O_1 as centre, represent the locus of the primary field of the constant-current transformer, $\overline{O1}$ being the primary current. Let $\overline{O4}$ be numerically equal to 20, $\overline{O\,1'}$ to 50, and $\overline{O\,1}$ to 60.

A current $\overline{O\,1'} = 50$ produces a field equal to $\overline{O\,1} = 60$, hindering the flow of the current. Hence, if the field is only $\overline{O\,4} = 20$, then a current of $\frac{60}{20} \times 50 = 150$ can flow through the transformer. This current is represented by $\overline{O\,4'}$. It can easily be shown that the points 1, 2, 3, 4 correspond point for point to the points 1', 2', 3', 4', the angle 301 being equal to 201.

Fig. 43 represents the circle O_4', reciprocal to O_4. Angle $O_4'\,O\,A$ is equal to angle $O_4\,O\,A$.

A concrete case will bring the matter into a more palpable form.

A transformer or induction motor requires a magnetizing current $i_0 = 5$ amp. We assume $v_1 = 0.91$ and $v_2 = 0.80$. The constant

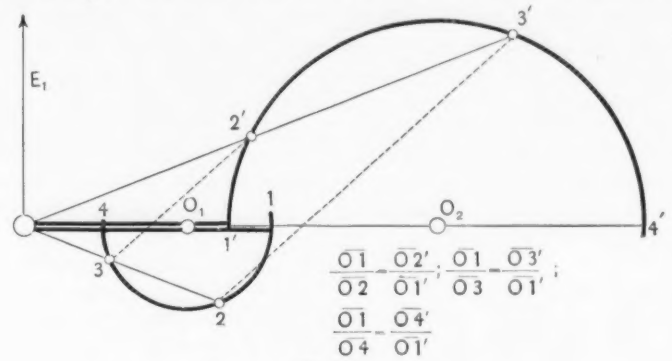


Fig. 42.

potential of the transformer be 110 volts. The resistance of the primary be 2 ohms. The semi-circle O_4 can then easily be constructed.

All that remains to be done is to construct the semi-circle for the constant-potential transformer. $\overline{O1}$, Fig. 44, is a field equivalent to 110 volts. $\overline{O\,2}$ is a field equivalent to 31.5 volts; hence, if the potential is kept constant at 110 volts, $\frac{110}{31.5} \times 5 = 174$ amp. will flow through the transformer at the same phase-angle. We thus get point 2. The centre of the semi-circle can at once be found, points 1 and 2 being determined, as angle $O_4'\,O\,A$ is equal to angle $O_4\,O\,A$.

The ordinates of the semi-circle O_4' represent the watt-current of the transformer, the ordinate of point 1 being equal to $5^2 \times 2 \div 110 = 0.455$, and the ordinate of 2 being equal to $174^2 \times 2 \div 110 = 5.5$ amp.

$\overline{O1}$; $\overline{O2}$ represent directly the primary currents.

To find the secondary currents I have redrawn the same diagram

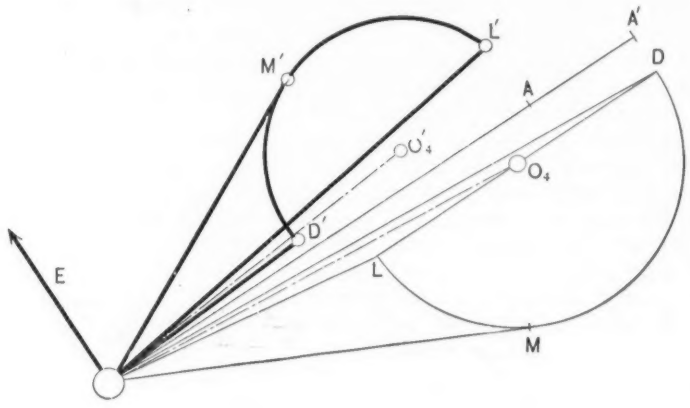


DIAGRAM ILLUSTRATING METHOD OF RECIPROCAL VECTORS.

Angle $O_4'O\,A_1$ = Angle $O_4\,O\,A_1$;
Angle $M'O\,A_1$ = Angle $M\,O\,A_1$;
Angle $L'\,O\,A_1$ = Angle $L\,O\,A_1$.
$\overline{OM} \cdot \overline{OM'} = \overline{OD} \cdot \overline{OD'} = \overline{OL} \cdot \overline{OL'}$

Fig. 43.

in Fig. 45. $\overline{O\,A}$ is the primary current, or, to be more strictly correct, the primary m. m. f.

$\overline{O\,M}$ is proportional to the terminal voltage of 110 volts in our case.

$\overline{M\,D}$ is proportional to $i_1 r_1$, the ohmic drop in the primary. It is drawn perpendicular to X_1, as the field that would be equivalent to the throttling action of the ohmic resistance must be in quadrature with the voltage necessary to overcome it.

$\overline{O\,D}$, then, is the primary flux F_1.

$\overline{C\,D}$ is the primary leakage-field ϕ_1.

$$\overline{C\,D} = \left(\frac{1}{v_1} - 1\right) \overline{O\,A}$$

$\overline{C\,G}$ is the secondary leakage-field ϕ_2.

$$\overline{C\,G} = \left(\frac{1}{v_2} - 1\right) \overline{A\,C}$$

$\overline{O\,G}$ is the secondary field F_2. By means of the scale for the fields the secondary voltage can at once be determined. It must be borne in mind that $\overline{O\,G}$ is not proportional to the voltage at the secondary terminals, but that it includes the ohmic drop in the secondary.

Though the preceding considerations offer no great difficulty in understanding them clearly, yet the transformer diagram becomes surprisingly simple if we neglect the resistance of the primary. And

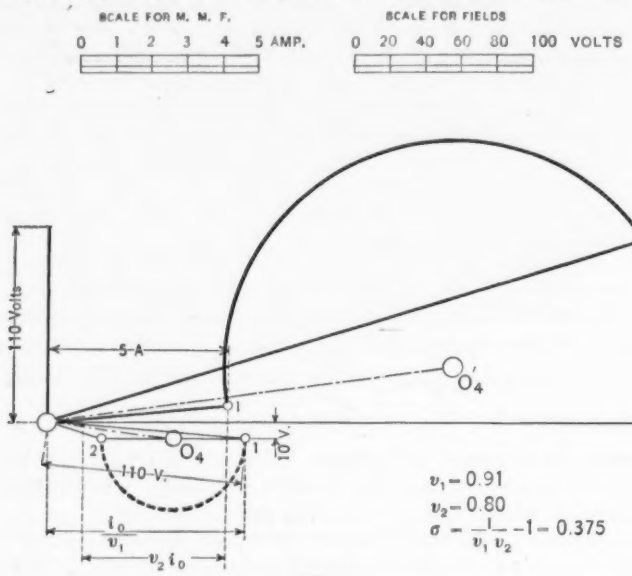


Fig. 44.

not only the diagram, but also its evolution, become so perspicuous that it seems peculiar that it has taken such a long time to arrive at this solution.

That the locus of the vector of the primary m. m. f. must be a semi-circle follows directly from the diagram of Fig. 41. This circle

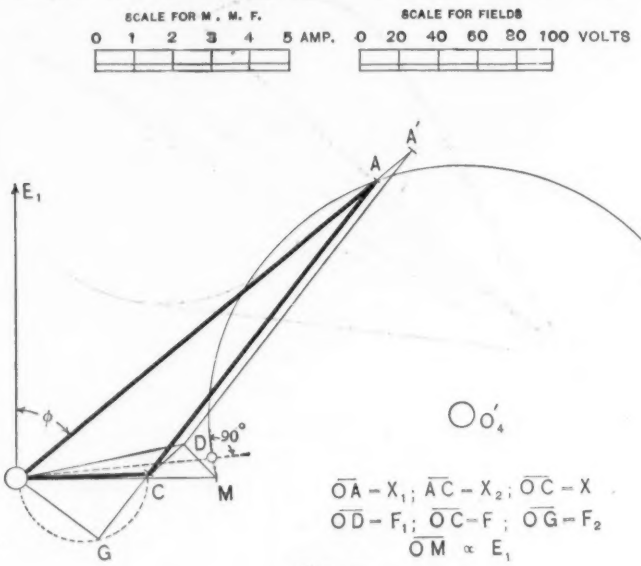


Fig. 45.

is reproduced in Fig. 46. The thick lines show the triangle of the magnetomotive forces.

$\overline{O\,C}$ is the magnetizing current. If the transformer runs on open-circuit, $\overline{O\,C}$ becomes equal to $\overline{O\,K}$. We see, therefore, that the magnetizing current is not constant for all loads, but decreases with the diminution of the secondary resistance. *What remains constant is the primary magnetic field F_1, which is composed of the common field F and the leakage-field ϕ_1. F is constantly diminishing, while ϕ_1 is increasing, their vector-sum being constant.*

K divides $\overline{O\,D}$ in a constant ratio, $\overline{O\,K} = v_1 \,.\, \overline{O\,D}$. Hence, drawing a line through K, for instance, $\overline{A\,K}$, and producing it until it in-

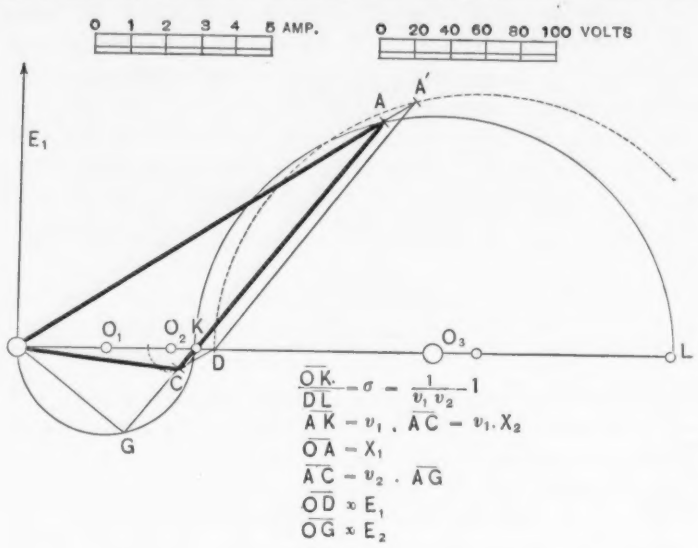


Fig. 46.

tersects the semi-circle in G, yield us all the data of the transformer that we are interested in.

INDUCTANCE IN SECONDARY.

There is no difficulty in drawing the diagram for a transformer working on an inductive load of constant power-factor. The development of the diagram is of the simplest if we neglect the primary resistance, which is generally perfectly permissible. Afterwards it is easy to correct the diagram with regard to the ohmic resistance of the primary, if this should be desired.

Let $\overline{O\,Q}$, Fig. 47, be the e. m. f. necessary to overcome the ohmic re-

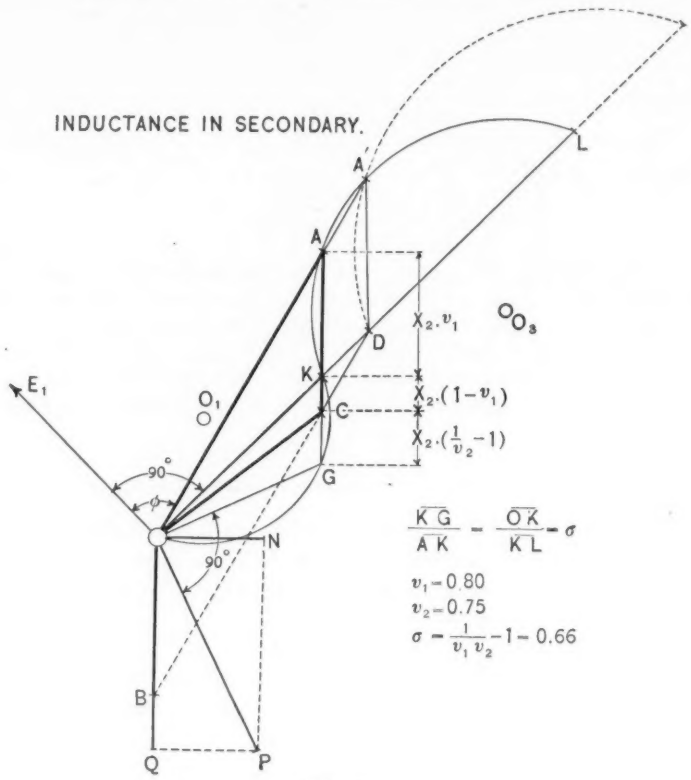


Fig. 47.

sistance of the secondary circuit, including the resistance of the coils of the transformer, and $\overline{O\,N}$ the e. m. f. required to overcome the external inductance in the secondary circut, then $\overline{O\,P}$ is equal to the e. m. f. required to drive the current through the whole secondary of the transformer. The field necessary to do this is $\overline{O\,G}$, in quadrature with E_2. $\overline{C\,G}$ is the leakage field of the secondary, $\overline{C\,A}$ is the secondary m. m. f. X_2, $\overline{O\,A}$ the primary m. m. f. X_1. $\overline{C\,D}$ is the primary leakage field. $\overline{O\,C}$ is the common magnetic field, and the scale of

X_1 and X_2 is so chosen as to give a resultant equal to $\overline{O\,C} = F$. $\overline{O\,K}$ is constant as $\overline{O\,D}$ is constant, $\overline{O\,K}$ being equal to $v_1 \,.\, \overline{O\,D}$.*

It follows at once from the diagram,

$$\overline{A\,K} : X_2 :: X_1 : \frac{X_1}{v_1}$$

$$\overline{A\,K} = v_1 \,.\, X_2.$$

As angle $O\,G\,K$ remains constant and equal to 180° — $P\,O\,N$, G moves in the arc $\overline{O\,G\,K}$. If the diagram is constructed for one point, the locus of G is determined.

To determine the locus of A we have to consider the ratio between $\overline{G\,K}$ and $\overline{A\,K}$, which we have called σ.

$$\overline{G\,C} = X_2 \left(\frac{1}{v_2} - 1 \right)$$

$$\overline{K\,C} = X_2 \,(1 - v_1)$$

For $\overline{A\,K}$ we have $v_1 \,.\, X_1$, hence

$$\sigma = \frac{\overline{G\,K}}{\overline{A\,K}} = \frac{\frac{1}{v_2} - 1}{v_1} = \frac{1}{v_1\, v_2} - 1$$

Hence the locus of A is an arc the chord of which is determined by the ratio.

$$(5) \ldots\ldots\ldots\ldots\ldots \sigma = \frac{1}{v_1\, v_2} - 1 = \frac{\overline{O\,K}}{\overline{K\,L}}$$

The centre of this arc is determined by the angle $O_2\,K\,L$, which is equal to $Q\,O\,P$, the angle of lag in the secondary. Angle $O_1\,O\,K$ is equal to $Q\,O\,P$.

CAPACITY IN THE SECONDARY.

Fig 48 is constructed for a capacity in the secondary in series with the resistance. Angle $\overline{P\,O\,B}$ is the secondary lead, F_2 is the

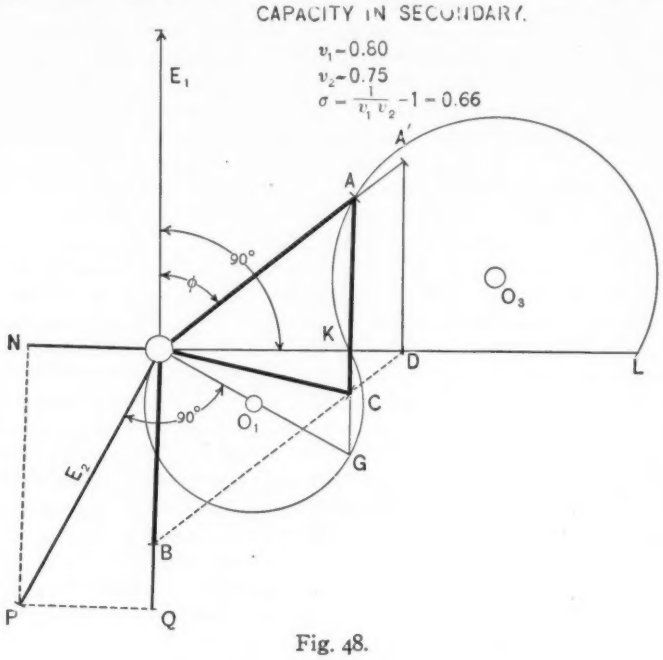


Fig. 48.

secondary field, triangle $\overline{O\,A\,K}$ is the triangle of the m. m. ff. We find exactly as before:

$$\frac{\overline{O\,K}}{\overline{O\,L}} = \sigma = \frac{1}{v_1\, v_2} - 1$$

Bearing in mind that angle $O\,G\,K$ is constant and equal to angle $N\,O\,P$, it follows at once that the locus of G and that of A are circles.

Again angle $O_2\,K\,L$ is equal to angle $O_1\,O\,K$, equal to angle $P\,O\,Q$, the angle of the secondary lead.

HYSTERESIS AND EDDY CURRENTS.

A word about the way in which hysteresis and eddy currents should be taken into account. Assuming them to be constant for all loads—which they are not, as, if the leakage-path is slightly saturated, the leakage-flux becomes greater with larger currents, and the greater loss in the leakage-path may outdo the decrease of the loss in the main field—it seems most logical to take these losses into account by assuming a lag between the common field $\overline{O\,C}$ and the magnetizing current. This lag diminishes the secondary current. Draw a line parallel with $\overline{L\,D}$, the distance of which from $\overline{L\,D}$ being equal to the loss in watts through hysteresis and eddies divided by the primary voltage, then the secondary currents must be measured between this line and the semi-circle O_2.

I wish to impress upon the reader that there is little in this contribution that I can claim specially my own. I have merely combined the diagrams of Kapp, Steinmetz, and Blondel, simplifying wherever it was possible. The application of the principle of reciprocal vectors† enables us in a surprisingly simple manner to trace out the intricate phenomena in the transformer for constant potential, if we want to include the primary resistance. My method of arriving at the diagram of the general transfomer is different from Dr. Bedell's in so far as he uses the coefficients of self- and mutual induction, a method which I cannot advocate.

A very beautiful and simple diagram can be drawn, showing in polar co-ordinates the locus of the primary current for a lag, non-inductive load, and a lead in the secondary, as for the same transformer or motor $\overline{K\,L}$ is a constant if $\overline{O\,K}$ is constant. Neglecting the primary resistance, a diagram can be constructed for constant terminal voltage by erecting arcs over $\overline{K\,L}$ as chord. Arcs flatter than the semi-circle correspond to an inductance in the secondary, the semi-circle corresponds to a non-inductive load, and an arc whose inscribed angle is smaller than a right angle, standing on $\overline{K\,L}$ as chord, determines the locus of the primary current for a condenser in the secondary. As the secondary terminal voltage is determined by the circle O_1, in the most simple and beautiful manner the phenomena of resonance and kindred phenomena may at a glance be qualitatively and quantitatively understood. But I must leave the construction to the reader, who will find no difficulty in building up the diagram synthetically with the help of Figs. 46, 47, and 48. It is worthy of notice how injurious an inductance is with regard to the maximum energy the transformer or motor is capable of taking in, and how much a condenser in the armature of the motor would increase the power of the motor to do work.

Russian Telephone Concessions.

A dispatch from St. Petersburg says: The telephone franchises were sold at auction Nov. 20. The new régime begins in November, 1901. The Government has prescribed the conditions of rental, and the franchises were given to the parties fixing the lowest subscription. The St. Petersburg Municipality won in this city, agreeing to demand 45 rubles annually, compared with 250 rubles hitherto charged. The Western Electric Company, of Chicago, bid unsuccessfully everywhere. The rates for subscriptions accepted are: Odessa, 48 rubles; Riga, 57 rubles; Warsaw, 69 rubles, and Moscow, 79 rubles. The prices for restaurants, hotels, etc., are 30 per cent higher for a single user, and 10 to 20 per cent lower for telephones in general use.

Telephone Conditions in the Rocky Mountain States.

The Rocky Mountain Bell Telephone Company, which has headquarters at Salt Lake City and operates in the Rocky Mountain States (except Colorado), has not gone into the nickel-in-the-slot private party line business, but has something which is very near an equivalent to it. This is an 8-party line service at a rental of $1.50 per month. Subscribers are allowed 100 calls per month without extra charge, but for all more than 100 per month a charge of 5 cents per call is made. It was a surprise when this service was first introduced that subscribers soon began to use more than 100 calls per month. In fact, the average is about 4⅓ calls per day. Of course this brings the rate per message very low. Salt Lake City, with a population of 59,000, has about 1600 subscribers.

*This diagram is identical with that given by Herr Emde in the *Elektrotechnische Zeitschrift*, Oct. 11, 1900. I refer the reader to Herr Emde's important contributions on this subject, as well as to his valuable criticism of my paper of 1896 on the general transformer. See also Herrn Heubach's, Kuhlmann's, and Sumec's letters on the same subject there.

†The method of reciprocal vectors was admirably treated in 1878 by Prof. W. K. Clifford in the chapter on "Pedal and Reciprocal Curves" in his work on "Elements of Dynamics." But Dr. Bedell first applied the principle to the transformer.

Graphical Treatment of the Effect of Armature Current on Wave-Form of Alternator.

By F. G. Baum.

In an article published in Electrical World and Engineer, May 20, 1899, the writer showed graphically the effect of leading or lagging current on the regulation of an alternating-current generator. Figures similar to those there given may also be used to show the effect of the armature current on the wave form.

Fig. 1 represents a two-pole alternator, the armature coil represented by a single turn of wire revolving between the poles *N S*. Let us assume that this alternator gives a sine wave on open circuit, and then determine the effect of (1) a current in phase with the e. m. f., (2) a current 90 degs. behind the e. m. f., and (3) a current 90 degs. ahead of the e. m. f.

Case 1. Current in phase with the e. m. f., Fig. 1a. When the coil is in the position shown, the plane of the coil being parallel to *N S*, the current will be a maximum. The magnetomotive force of the coil will always have a direction at right angles to the coil. In the position shown let *o a* represent the magnetomotive force of the coil. When the coil is in the position *o P* the current is proportional to *o p*, the projection of *o P* on a line parallel

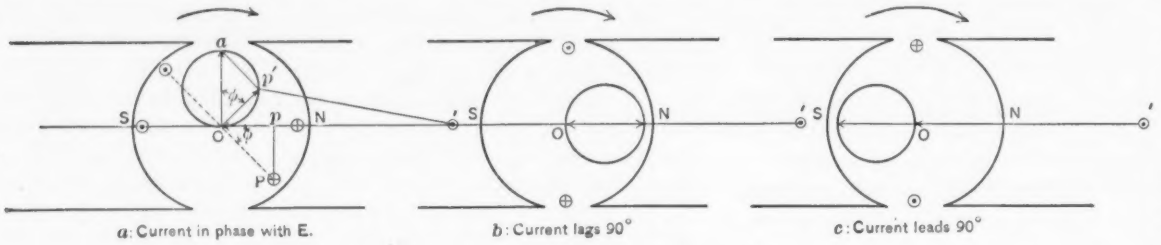


FIG. 1.—MAGNETOMOTIVE FORCE TRIANGLES.

to *N S*. From *o* draw a line at right angles to the direction *o P* and from *a* drop a perpendicular *a p'* on *o p'*. Then by construction *o p'* represents the magnetomotive force of the coil in magnitude and direction for the position *o P*. We see that *p'* lies on the circumference of a circle *o a p'* with *o a* as a diameter. The circle represents, therefore, the locus of the magnetomotive force of the coil in all positions.

Now, on the same scale that *o a* represents the magnetomotive force of the coil when carrying maximum current, let *o' o* represent the magnetomotive force of the field winding on the alternator. The instantaneous value of the magnetism, then, for the position of the coil *o P*, is *o' p'*, and similarly for the other positions of the coil. It is seen that for about one-half revolution of the armature, the magnetism of the alternator is increased and for the remainder of the revolution it is diminished. The e. m. f. generated by the coil at any instant is, of course, proportional to the strength of field at that particular instant. Let the sine wave, represented by the dotted line in Fig. 2a, represent the e. m. f. of the alternator when carrying no current. Then when there is a current in phase with the e. m. f. generated by the armature, the e. m. f. will be as given by the full line in the same figure; *o' p'* and *o' o*, Fig. 1a, being practically parallel, the

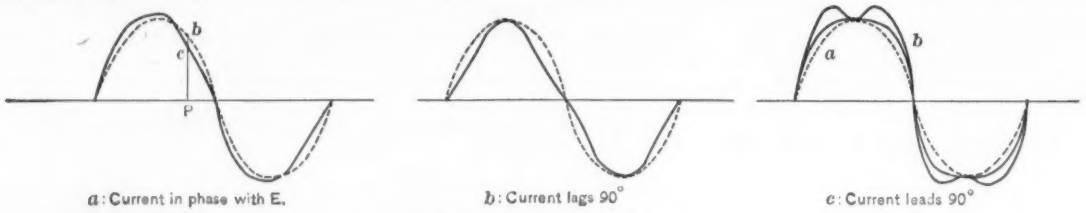


FIG. 2.—CURVES OF E. M. F.

ratio of the ordinate *P c* to *P b*, Fig. 2a, will be equal to the ratio of *o' p'* to *o' o*. The e. m. f. is raised on the ascending and lowered on the descending side of the curve. The square-root of the mean-square of the distorted curve will be about the same as that of the sine wave.

Case 2. Current lagging 90 degs. behind e. m. f. In this case it can be easily proved that the curve representing the magnetomotive force of the coil will be rotated through 90 degs. to the position shown in Fig. 1b. (For an angle of lag θ the line *o a* will rotate clockwise through an angle θ.) We see here that the armature current tends to demagnetize the field in all positions of the coil. Plotting again the values of the e. m. f. generated in different positions we get the curve represented by the heavy line in Fig. 2b. We see that a lagging current tends to produce a peaked wave, and also decreases the effective value of the voltage.

Case 3. Current leading e. m. f. by 90 degs. The circle representing the magnetomotive force of the coil has now a position as shown in Fig. 1c. We see that the armature current tends to magnetize the field in all positions. Plotting the curve of e. m. f. we obtain the heavy line (*a*) in Fig. 2c. We may even get a curve as represented by (*b*) in Fig. 2c, as an extreme case. A leading current, as may be easily seen from these curves, tends to flatten the e. m. f. wave, and also to increase the effective value of the voltage.

Electric Lights Along the Coast.

By Geo. E. Walsh.

In the construction of lighthouses, lightships and signal lights of a miscellaneous character along our coast to warn mariners of their danger, electricity has only recently figured to any great extent. There are some 9000 "aids to navigation" scattered along our ocean and lake coasts, and these vary in size and importance from the small beacon to the most powerful lighthouse in the world. These lights, beacons and buoys are operated by steam, hot air, gas, electricity and by the force of the waves. More than 6000 of these "aids to navigation" are of use only in the day time, and the other 3000 send their warnings across the water by means of powerful lights.

For hundreds of years the lighthouses of the world depended upon the oil lamp for their signal lights, and inventors simply multiplied their intensity by inventing new forms of reflectors. It is a notorious fact that on some of the foreign coasts these old-fashioned oil lamps are still in existence, and even on our own coasts the modern gas or electric lights are of very recent introduction. The United States Lighthouse Board has gradually been reorganizing the whole lighthouse service, and to-day nearly all of these sleepless watchers of the night are provided with electricity. The cost of this lighting agent has been the chief obstacle in the way, and even to-day there are isolated coasts and points where the Lighthouse Board has not felt justified in introducing the electric light.

Where it has been impossible to use the lighting power from some neighboring electric light plant, the government has in a number of instances established its own plant. Acetylene gas has been employed in many a lighthouse located where it was not considered wise to establish an electric plant. This gas gives a much better effect than common illuminating gas, and it is used entirely in buoys where gas is the lighting agent.

The revolution in the work of lighting our coast is coming slowly through the application of electricity to various kinds of buoys and beacons. Some time ago the Lighthouse Board made successful experiments with electric buoys in New York Harbor. By means of an electric cable connecting the line of buoys marking the channel, the passage up the harbor could be made as easily as in the day time. There is little question but harbors will be ultimately lighted in this way by electric buoys, especially for a part of the night. The delay of incoming steamers and ships in a port like New York because of the danger of navigating a narrow, crooked channel is a matter of considerable commercial loss, and anything that would facilitate the landing and docking as soon as the steamers arrived would prove of great advantage to the shipping interests.

In establishing such lines of electric buoys the question of cost must always be considered, and at present the Lighthouse Board has not proceeded beyond the experimental stage. In other lines of work with electricity, however, something more than experiment has been attained. Nearly all the future lightships will have an electric light plant on board to furnish sufficient illumination to warn ships off the

shoals. This departure from the old-fashioned lightships will be noteworthy in many respects. The ships will be provided with hollow iron masts, and at the top of each will be grouped half a dozen incandescent lamps, each of 100 candle-power. There will be two complete sets of electrical apparatus so that if one should be deranged the lights would not suffer.

The first and most powerful of these modern electric lightships will be located off Cape Hatteras. The famous Diamond Shoals is the scene of this new venture. For half a century these shoals have been the most dangerous point on our coast. The shoals are formed by the powerful set of the tide up and down the coast at Cape Hatteras, which juts further out into the Atlantic than any other point of land south of the Delaware Capes. Storms seem to be forever brooding off this point, and the shifting nature of the sands makes it impossible to warn passing ships without a light. Numerous wrecks have occurred on the shoals, and vain efforts have been made to build some sort of beacon or lighthouse at the place. The latest attempt was to sink a huge caisson into the sandy bed of the shoals and then build a lighthouse up from this secure foundation. Twice the company employed in sinking the caisson was baffled and the caisson was finally wrecked. Several lightships have been anchored there at various times, but they were torn loose from their moorings and carried out to sea.

The construction of a special lightship was then ordered by the lighthouse board, and this is the most modern and improved type of lightship in the world. The lightship is steam-propelled and electric-lighted, and is 112 ft. long, with a beam of over 28 ft. The ship is built of steel, with watertight compartments. The dynamos and engines for the electric light plant are located on the main deck and in the engine room and boiler casing. The wires run from the plant through the steel masts to the flashlights. There are three of these flashlights on each of the two hollow masts, and they are arranged for oil as well as electricity.

The lights are nearly 60 ft. from the water line. These six masthead lights are of 100-cp 100-volt lamps, and they can be seen many miles at sea at night time. They are regulated on the automatic flash system, which is controlled by a belt from the dynamo shaft. There will also be 80 16-cp 100-volt lamps placed at different points on the ship. These are intended to illuminate the waters so that a passing ship could not mistake the meaning of the lights. The electric plant is driven by two double-cylinder engines.

The lightship itself will be operated and controlled by steam. There will be a steam siren and a steam whistle to warn vessels off. The mooring apparatus will be of the most elaborate type, and the tackle will all be operated by steam or electricity.

The power of the illuminating lights for both lighthouses and lightships has not only been increased in the last few years by the adoption of electricity, but also by the improvement in the reflectors and lenses. These lenses are ground so fine now that the lighting effect is doubled and trebled in some instances, and the navigator today can distinguish the lights of the coast two or three times as far out at sea as formerly.

The Lighthouse Board has been experimenting extensively with electric flash lights for the purpose of adopting a uniform system of signals along all the coasts. The great trouble with arranging lights has been to find suitable variations of lights to give sailors an accurate knowledge of their whereabouts. The use of the colored lights, either as stationary or flash lights, has the disadvantage of failing at a critical moment through the color blindness of the navigator. More than once signal lights have been misread through this trouble. It is impossible to make tests of all navigators as to their color blindness, as is the rule on the railroads, and the dependence upon colored lights is deprecated more and more each year.

The modern lighthouse not only warns mariners of danger, but it is supposed to inform them of their exact location. This is done through a system of electric light flashes, according to which each lighthouse emits a certain number of rays of light, followed by total eclipse, and then by other flashes. These rays of light are supplied by electricity and are as powerful as the electric arc permits. Mariners' charts give the key to each light. By referring to this chart the navigator can tell instantly what light he is sailing abreast. By means of the electrical apparatus the simple opening and closing of the circuit will furnish automatically the desired number of flashes per minute. There is no other power or agent that can furnish similar powerful flashes in the order needed, and electricity will come to be installed in all lighthouses where the flash system is in use, displacing the present clock-like machinery to produce the flashing effects, as there are many insurmountable difficulties in the way of its efficient working. The electric light system has so far proved by all odds the most economical and trustworthy, and its adoption as the only really satisfactory one for lighthouse service seems assured. More money is spent by the United States than any other country in the improvement of its lighthouse service, and it requires between $3,000,000 and $4,000,000 a year to support it. Efforts are being made to reduce this cost by constructing machinery which can be operated by the waves. In this way it is hoped to generate sufficient electricity at little expense to furnish the lights.

CURRENT NEWS AND NOTES.

RAILWAY TELEPHONY.—It is understood that the Northern Pacific Railway proposes to install a telephone service for handling some of its freight traffic.

CHICAGO ELECTRICAL EXPOSITION.—The Chicago Trades' Exposition Company announces an International Electrical Science Exposition in March, 1901. We should think electrical manufacturers will find Buffalo about all they want in the exposition line next year.

TAXING FRANCHISES.—Corporations in New York State have organized to contest the legality of the State Franchise Tax Law Franchises have been assessed under the law for $266,163,059 in the entire State. Of this amount the franchises owned by New York city corporations are valued at $219,679,351. These figure represent an increase of assessment over last year of $170,000,000, which, would yield $4,250,000 in revenue.

MUNICIPAL LIGHTING PLANTS.—There is a scheme on foot among several cities and towns in Connecticut to fight the law restricting the establishment of municipal lighting plants and to secure its repeal if possible, or else override it by amendments to their charters which will allow cities to control and operate plants. The principal towns agitating the question are Wallingford, Willimantic, New London and New Britain. The municipal plant at South Norwalk has been visited by various committees from these towns.

NORTHWESTERN ELECTRICAL ASSOCIATION.—The ninth annual convention of this association will be held at the Hotel Pfister, Milwaukee, Wis., on Jan. 16, 1901. Reports and papers on subjects of special interest to central station men will be read and discussed. Hotels and railroads have made special rates for the occasion. Information about wiring, current, etc., for exhibits can be obtained from Mr. O. M. Rau, 451 Broadway, Milwaukee, and about railroad arrangements from Mr. James Wolff, 320 Dearborn Street, Chicago.

ELECTRIC LAUNCHES IN MEXICO.—Word is received from San Juan Bautista, State of Tabasco, says the *Nouveau Monde* of Paris, that the English Navigation Company on the Rio Grijalva has inaugurated a daily service between the port of Frontera and Huimanguillo. These boats are operated by means of electricity, as well as is the "Gola," built at San Juan Bautista, for a Frenchman, Mr. Rauld. The latter vessel has for the second time made the voyage from Tacoltapa. The freight is considerable, consisting principally of sugar, cacao and coffee and barrels of rum.

NERNST LAMP HEATER.—In a patent, issued Dec. 18, to Carl D. Raab, of Kaiserslautern, Germany, a heating system is described which involves the employment in parallel with a Nernst lamp of an ordinary incandescent lamp, and the use of a transformer having in its secondary the heater for the Nernst lamp. The wires of the two lamps in parallel form the primary of a small transformer, and are so wound as to induce equal but opposite magnetic fluxes. By this arrangement the transformer is thrown into action by the current passing at first entirely through the ordinary incandescent lamp, a current then being induced in the secondary, which heats the Nernst lamp. As the latter becomes conductive, the current flowing through it introduces an opposite magnetic flux in the transformer, which finally reaches a normal strength that neutralizes the action of the current passing through the incandescent lamp, and thus stops the flow of current in the heater connected with the secondary.

THE UNIVERSITY OF WISCONSIN will ask of the Legislature an appropriation for an addition to the Mechanics' Art Building for class room service and for a new building to house the electrical laboratory and electrical generating plant, the amount asked to be sufficient to provide a new electric lighting and power plant.

REQUEST FOR CATALOGUES.—On the night of Dec. 16, 1900, the offices and drafting rooms of the Department of Construction and Repair, Navy Yard, Norfolk, Va., were entirely destroyed by fire, together with their records, plans, correspondence, catalogues, price-lists, etc. Naval Constructor A. W. Stahl, U. S. N., head of that department, will be pleased to receive copies of catalogues and price lists of electrical supplies, apparatus and materials and of other Navy Yard supplies, in order that the files and records of the Requisition Office of that department may be replenished.

WIRELESS TELEGRAPHY IN HAWAII.—A dispatch from Honolulu of Dec. 14 says: Wireless telegraphy is meeting with much success in Hawaii. A large number of messages have already been transmitted from one island to another. The company which is seeking to put the system in operation lately chartered the yacht La Paloma to cruise among the islands to test the possibility of communicating with ships at sea from land. The tests are said to have been successful. Experiments are now in progress to determine the best locations for the stations on several islands. When this has been completed stations will be connected by ordinary telegraph lines with the centres of population, and regular transmission of commercial business will be begun.

BUSINESS DEPRESSION IN GERMANY.—A late number of the Brunswick *Landeszeitung* says that there is a decrease of 37.4 per cent in building enterprises in Germany, as compared with the summer of 1899; of 58 per cent in railroad projects, of 63.43 per cent in construction of electrical and street railroads, of 32.33 per cent in projected electrical plants for lighting, etc. The number of projected gas works is almost a third less, but, in view of size and percentage of production, there is little difference. In other spheres of activity, such as mining and smelting, work in stone and earth (fertilizing salts, etc.), metal manufacture, production of chemicals and textiles, breweries and water works, a difference of 27.2 per cent is shown.

REGULATION OF ROTARY CONVERTERS.—If a rotary converter is located at a point on a line between the generator and translating devices further on, the regulation becomes imperfect to an extent dependent upon the phase relation and amount of current taken beyond the converter. To remedy this defect, Charles P. Steinmetz, in a patent granted Dec. 18, describes a method whereby the strength of the exciting field of the rotary converter may be varied to counteract variations due to the current carried past the converter. As illustrated, an induction motor connected to the line beyond the converter to be regulated, drives a small rotary converter. The direct current side of the small converter is in series in the shunt winding of the large converter, which winding is thereby supplied with current to compensate for the line action incident to the current passing beyond.

COMPENSATING ALTERNATORS IN PARALLEL.—The type of self-regulating alternator known as "compensating alternator" when run in parallel is subject to the defect that one machine will automatically increase in strength while that of another will decrease, in some cases the action going to such an extent as to entirely kill the field of one machine. In a patent granted Dec. 18 to W. L. R. Emmet, a simple means of obviating this defect is described, which consists in the use of equalizers connecting together the regulating series transformers inserted in the mains of each alternator, these transformers forming part of the usual compensating system. By this means the compounding effect of one alternator will affect all of the alternators in parallel, and thus the compounding effect in each machine will rise or fall with that of the other machines, thereby effectually preventing the instability above referred to.

NEUTRAL POINT REACTIVE COILS.—In alternating current machines of the rotary converter type it is frequently desirable to obtain a point having a potential neutral with respect to the distribution of potential about the commutator, thereby enabling the connection of a neutral conductor to this point. The point of neutral potential is usually obtained by the use of reactive coils across the winding and joined to a common point between the coils constituting the point of neutral potential. In taking off large currents, however, the cores of the coils are apt to become over-saturated, and to obviate this objection is the subject of a patent granted Dec. 18 to Charles P. Steinmetz. The coil is supplied with a secondary winding of half the number of turns of the usual reactive winding, through which coils the neutral current is caused to flow in such a direction as to neutralize the increased magnetization that would otherwise be caused by a large current flowing through the reactive coils to the neutral line.

ALTERNATING CURRENT MOTOR STARTING DEVICE.—In a patent issued Dec. 18 to Prof. Elihu Thomson a means is described for starting alternating current motors having a moderate or feeble starting torque, as for example, single-phase motors of the induction type provided with "shading coils." In starting such motors, a portion of the field is short circuited to "shade" or modify the poles, which causes a rotating magnetic field by which means the motor may without load be brought up to speed. The invention consists in providing a centrifugal arrangement whereby the motor will be coupled to the working shaft when normal speed has been attained. The type of clutch illustrated consists of an arrangement of annular disks secured to the inner part of the rotor and meshing with disks of the shafting. The disks are alternately secured to the rotor and shaft, and each set is mounted by means of keyways so as to be capable of longitudinal motion. When at normal speed, the centrifugal arrangement exerts sufficient force to press the two sets of disks together sufficiently to give rise to an amount of friction that will couple the rotor to the shaft.

CANAL TRACTION IN BELGIUM.—United States Consul Roosevelt, of Brussels, reports that the company which was organized in that district in 1898 to establish electric traction on navigable ways in Belgium closed its books for the first time on June 30, 1900, with a balance of $5,074. Nearly all the time since its organization has been devoted to erecting buildings and putting in machinery. Electric traction was first put into operation by the company between Virginal and Ruysbroeck, a distance of 22 kilometers (13.669 miles), and worked satisfactorily by means of thirty tractors and four electric tugs. Eleven communes have already contracted with the company for public lighting for a period of thirty years, and other communes are negotiating for the same purpose. The company has recently submitted to the government proposals for lighting eleven railway stations between Brussels and Charleroi. The managers believe that before the ending of the third fiscal year, their contracts will embrace 10,000 lamps, which, estimated at 15 francs ($2.89) per lamp, will represent an annual revenue of 150,000 francs ($28,950). Negotiations are now going on for supplying 242 horse-power from 10 to 20 hours per day. From this branch of the enterprise the company calculates upon an annual income of at least 125,000 francs ($24,125). It is equipped to supply electricity for towing by day and night, for small and medium industries, and eventually for vicinal rail and tramway lines and night public lighting.

THE PROPOSED PHILIPPINE CABLE.—Work is now being done in Washington, it is alleged, in the interests of the American Steel & Wire Company, the Amalgamated Copper Company and the Western Union Telegraph Company to secure the adoption of the bill which will come before the present session of Congress providing for the laying of a cable from the Pacific Coast to the Philippines, touching at Hawaii and Guam. As now drawn, the measure provides that the cable shall be owned and operated by an American company, that it shall be manufactured in the United States and that it shall be laid by vessels flying the American flag. The only opposition which has thus far appeared to the bill has come from the Democrats who have advocated the ownership of the cable and its operation by the government. Should it be decided that the government should lay the cable, it is not at all likely that a change would be made of the clause which provides that the cable shall be of American manufacture. The first cable is approximately estimated to cost about $11,000,000, the second cable the same figure, and other connections costing about $600,000 additional. At the present time the only concern in the United States, it is asserted, that could turn out the entire cable within the stipulated time of five years, allowing a year at least for laying and making necessary connections, is the American Steel & Wire Company. Some of the other well-known cable manufacturers are understood to stand ready to do the work.

ARMORED TRAMWAY CARS appear to be a necessity of the hour in Paris not less than in some American cities. It is stated that some outlying districts of the French capital are overrun by banded toughs known as Apaches. A special dispatch says: "A trolley company, which runs a line through the quarters in question, has made an application, either to close its service at an early hour of the night, or to be supplied with a guard of police for each of its cars for fear that some night one of them will be attacked by the bold redskins of the 'Barrière,' whose exploits will doubtless not have long to wait for their Gustave Aymard or their Fenimore Cooper. An armed tram car for cities, as a pendant for the armored trains of war, would indeed be a novelty flattering to our advanced civilization."

AUTOMOBILES IN THE SNOW.—The reliability and convenience of an automobile service were shown to splendid advantage last week in Atlantic City, where the Electric Vehicle Company maintains a service for the hotels. Twelve inches of snow fell on Friday, Dec. 21, blocking railroads, trolley cars and nearly all the public conveyances. The automobiles, however, continued to operate almost with the same degree of regularity as under normal conditions of traffic. Those of the cabmen who were able to weather the storm with their conveyances sought to make of it a golden opportunity for extortionate rates. The automobile service ran under its regular rates and won general favor for its serviceableness in the emergency. A similar situation was encountered during a recent snow storm at Lakewood, where a Columbia automobile is in operation for the Lakewood Hotel. There was no interruption in the service, and patrons were carried between the hotel and the railroad station without any delay.

LETTERS TO THE EDITORS.

Motor Starters.

To the Editors of Electrical World and Engineer:

Sirs:—The very extensive use of electric motors and the rapid increase in their introduction makes the subject of motor starters one of growing importance. It is very rarely that a specification for a motor starter is met with, and it is certainly a matter of importance that the features of a first-class motor starter should be well understood.

In order to call your attention to this subject in concrete form, I enclose you herewith a specification which covers the features which seem to me of the greatest importance in a starter. This specification can be readily complied with, and each particular feature is contained in several well-known types now on the market.

SPECIFICATIONS FOR A PERFECT MOTOR STARTER.

1. The starter must stand without injury or alteration a current of 50 per cent in excess of the full load motor current when passed through the entire resistance when cold, for one (1) minute.

2. The starter must stand without injury or alteration a current which is double the full load motor current, when passed through the entire resistance, when cold, for twenty (20) seconds.

3. The resistance must be of metallic alloy of high fusing point and having a temperature coefficient not greater than that of German silver. Resistance materials whose resistance alters greatly when heated, such as copper, iron and carbon, will not be acceptable.

4. The resistance material must be surrounded by, and mechanically held in position by a high-class insulating material, so that in case the conductor be melted by excessive current, or broken by mechanical strain, the conductor cannot move.

5. It must be absolutely impossible to make a fire in case the resistance be burned out by overload current. The insulating material must not smoke, smell, steam or suffer any alteration or depreciation when tested as above provided.

6. The starting arm of the motor starter must have an efficient retractile spring constantly tending to insert the resistance and open the circuit to the motor and which will invariably do so when the arm is released by the automatic "no voltage" device. In all starters whose full load current is over 80 amperes the spring must be supplemented by an auxiliary device such as a "hammer blow" to start the arm against the friction of rest when it is released.

7. The starting arm must be held in its full speed position by a "no voltage" device which will be unaffected by any variation in the load, but which will invariably release the starter arm when the supply voltage fails.

8. The starter must be provided with an overload magnetic circuit breaker whose action is entirely independent of the "no voltage" device and which will open the circuit to the motor whenever the current exceeds a predetermined maximum, either while the operator is starting the motor or after it is at full speed. This circuit breaker must be so arranged that it cannot be closed except when the starting arm of the starter is in its open circuit position.

9. In all starters of 10 horse-power and larger the circuit breaker must be provided with an auxiliary final break, upon which the arc is broken so that the switch contacts of the circuit breaker will not be burned when the circuit breaker opens.

BRONXVILLE, N. Y. H. WARD LEONARD.

Use of Lighting Schedules.

To the Editors of Electrical World and Engineer:

Sirs:—With regard to the Moonlight Tables for 1901, we would like to ask if they are correct for our locality on sun time. We also note that in the Standard Table column, the 27th of January, the 25th of February, etc., there are no times given for lighting or extinguishing. Is this an error? If not, what time should be used?

ANN ARBOR, Mich. ANN ARBOR ELECTRIC COMPANY.

To the Editors of Electrical World and Engineer:

Sirs:—For latitude of Ann Arbor, 1901 tables are slow approximately five minutes. It is to be borne in mind that the tables referred to are made up on sun time, and if in Ann Arbor standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made to all the time given in the tables.

The reason that blank line in January is prefixed Jan. 27, is because line above dated 26th, column light is 11:30 P. M., same line morning date is 27th, extinguished 6:15.

While it is the same night, still lighting was begun on evening 26th and extinguished morning 27th. Now, as the next lighting is not to take place until 12:40 A. M., of the 28th, the line 27th necessarily must be left blank.

This answers interrogatory as to February, as the times for lighting and extinguishing are not given for the day on which the night commences, except, for example, Jan. 1st, to 10th, of the month.

VINCENNES, Ind. H. W. FRUND.

The Design of Large Alternators.

To the Editors of Electrical World and Engineer:

Sirs:—In an article entitled "In the Power House of the Paris Exposition," which appeared in your issue for Nov. 10, we notice in the last paragraph a passage which is likely to give your readers the impression that the design of our alternators is copied from that of other makers. Seeing that this is entirely in opposition to the facts of the case, we beg you to allow us to call attention to the fact that we were the first to introduce this feature of a fixed armature capable of being turned round for the purpose of examination and cleaning. Moreover, the method adopted by some of our competitors for rotating the armature by loosening the frame, allowing it to rest on wooden wedges driven in between the face of the armature core and the field poles, strikes us as being most unmechanical and is certainly only a makeshift in order not to infringe our patents.

Coming now to the contention that our type of armature with radial arms involves greater complication and considerable weight, we would remark that, although we have now turned out some 100,000 horse-power of this type of alternator, this is the first time we have heard it termed complicated. As regards the question of weight, our type is not heavier and can be made lighter than the open type. We have built alternators of both types and are therefore in a position to judge. Indeed, it is obvious that with our type, which is supported by radial arms, a much lighter frame can be used than with the open type armature which is quite unsupported and must consequently be made much stiffer. Moreover, our type has the advantage of ensuring the concentric position of the magnet-wheel with respect to the armature.

BROWN, BOVERI & CIE.

BADEN, Switzerland.

The Use of "Boosters" in Cable Laying.

To the Editors of Electrical World and Engineer:

Sirs:—I notice in this week's issue of one of your contemporaries a letter from Mr. Herbert Laws Webb, calling attention to an editorial which had appeared in the Dec. 5 issue of that paper. The final paragraph of that letter will be sufficient to quote, although the whole letter is one well worth reading. The final paragraph reads as follows: "You will see, Mr. Editor, I draw from the tale of the Alaskan cable a slightly different moral from that which you draw in your enthusiastic editorial. I thoroughly admire Mr. Brixey's enterprise in building a cable many times longer than any he had ever built before, in shipping it on reels across the continent, in stowing it in a ship not equipped for cable laying, and in guaranteeing to lay it in good condition; and I also admire Mr. Porter's courage in taking charge of a job in which he had no previous experience, and the pluck and energy with which he pulled himself out of the difficult position in which the Orizaba placed him—and herself. What I do not admire, in these days when submarine cable laying has become an almost exact science, is the disregard of that science in the organization of the expedition and the exaggerated importance you give in your editorial to this shallow-water cable work as compared with the work of English cable concerns that have been occupied during the past 50 years in lacing the globe with cables in all depths of water and under all manner of conditions. If real deep-sea cable laying is to become an American industry surely it is better to face the real facts and conditions than to encourage the too common idea that 'enterprise,' 'boldness' and rule of thumb methods are better than experience, caution and skill."

It strikes me, as a reader of technical journals, that it is about time some one took occasion to point out the fact that such journals are too much given to what is known in American phraseology as "slopping over" in their anxiety to give their friends a "boost" in the shape of free advertising.

The case which Mr. Webb has so sharply taken up is probably as flagrant a one as has appeared in some time, the importance of the work having been so grossly exaggerated and such undue elation having been shown over the performance of a piece of work which could have been done equally well by other concerns, and probably would have been done by them without the flourish of trumpets which accompanied this.

I trust this may be a lesson to you, Messrs. Editors, not to fall into the same error over some other piece of work which may be done by some of your friends. I thank you for giving me space in your paper to express my views on this matter.

New York City. Otto Schroeder.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

Dynamos. Motors and Transformers.

Fitting Carbon Brushes.—An illustrated description of the Cowles device for grinding the contact surfaces of carbon brushes, in position. It is simple in construction and consists of a three-sided frame made of wire like the frame of a hack-saw, the fourth side of which is made of a piece of stretched sand paper, with the sand side toward the inside of the frame. This is applied to the commutator with the smooth side of the paper toward the commutator and the brush is adjusted to touch the sand side; the paper is then worked backward and forward, adjusting itself to the curvature of the commutator and grinding the face of the brush to fit it.—*L'Elec.*, Nov. 3.

Marine Dynamos and Engines.—Adams.—An article in which he shows how to get small bulk and weight per unity of capacity, as required on board ship. By suitable designs with wrought steel and steel castings in engines, and wrought iron, steel and steel castings in dynamos, the weights per unit of capacity may readily be reduced as much as 50 per cent for engines and 25 per cent for dynamos below those often found in ship electric plants.—*Marine Eng'ing, El'ty*, Dec. 12.

Diagrams of the General Transformer.—Two illustrated communications in which the long discussion of this subject is continued. Sumec shows that Behrend's diagram is correct and in full agreement with the Heyland diagram, but that Behrend's terms are somewhat liable to be misunderstood. Ossanna shows that the Blondel diagram is correct also in the case that the magnetic reluctance of the iron is constant, but cannot be neglected; he also gives a summary of the practical advantages of his own diagram.—*Elek. Zeit.*, Nov. 29, Dec. 6.

REFERENCES.

Slotted Armatures.—Sander.—An illustrated article on the distribution of the lines of force in the air-gap between a pole-piece and a slotted armature. He plots the geometrical form of the air-gap and the probable path of the lines of force. The whole number of lines of force, entering into one tooth and slot, is divided into three parts; those entering the top surface of the tooth, those entering the side surfaces of the tooth, and those entering the bottom surface of the slot. For each of these three parts he determines graphically the average length of the lines of force. Three simple formulas, given by him, enable one to find the numbers of lines of force entering those three surfaces just mentioned; also the ampere winding required for the air-gap. The method is explained by a numerical example.—*Zeit. fuer Elek.*, Nov. 18.

Alternators in Parallel.—Wikander.—A mathematical paper. In practice the designers of dynamos allow a certain maximum angle of displacement of the rotor from the normal position which it would have with uniform speed; at and below this maximum they guarantee good working in parallel. On the other hand, the engine designers guarantee a certain maximum degree of lack of uniformity of speed per revolution. It is therefore important to find a relation between the angle of displacement and the degree of lack of uniformity. He develops arithmetical formulas for this relation.—*L'Ind. Elec.*, Nov. 10.

Non-Synchronous Motors and the Theory of Magnetic Mirrors.—S. P. Thompson.—A German translation in full of his Como Congress paper, an abstract of which was noticed in the Digest Nov. 4, 1899.—*Phys. Zeit.*, Nov. 3.

Single-Phase Induction Motor.—Eichberg.—A very long, illustrated French abstract of his German paper, noticed in the Digest July 21.—*L'Eclairage Elec.*, Nov. 24.

Three-Phase Transformer.—Goldschmidt.—If the arrangement of three iron cores of a three-phase transformer is not entirely symmetrical, the currents and the watts per core at no load, are different in the windings of the three cores, although the e. m. fs. are exactly equal. This is explained by diagrams and by analysis in the present article.—*Elek. Zeit.*, Nov. 29.

Differences Between the Calculated and the Measured Iron Loss.—Kamps.—Some critical remarks on special points in the paper of Dettmar (Digest, Dec. 15).—*Elek. Zeit.*, Nov. 29.

Converters.—Perkins.—The second part of his illustrated serial (Digest, Dec. 22), discussing the use of motor generators and synchronous converters as boosters in direct current systems; the use of motor generators as frequency changers in alternating current systems; the use of synchronous converters for changing alternating into direct current, especially as exciters.—*West. Elec.*, Dec. 15.

Overcoming the Vibrations caused by Motors.—Cowper-Coles.—An illustrated reprint of the article abstracted in the Digest Dec. 15.—*El'ty*, Dec. 12

Lights and Lighting.

Nernst Lamp.—An illustrated article on Nernst lamps as made by a British company owning the patent rights for some non-European countries; the Westinghouse Company owns the patents for the United States and Canada, Ganz & Company for Austria and Italy, and the General Electric Company of Berlin for the other European countries. Each company has been left to work out a practical form of lamp on its own lines. The lamps of the British company are said to consume 1.7 watts per candle-power and to have a life of 500 to 1000 hours. Air is necessary for the burning of the lamp, at all

events with direct current; this is probably because a supply of oxygen is necessary to prevent electrolysis of the magnesia which is the basis of the filament, or perhaps rather to effect the reoxidation of the magnesium which is the product of the electrolysis. Several forms of lamps requiring spirit lamps as lighters, and also of self-lighters are described and illustrated.—*Lond. Elec.*, Dec. 7.

REFERENCE.

Theatre Lighting.—An illustrated article on the electric lighting of the Illinois Theatre in Chicago. Direct current is supplied from the street mains; the three-wire system is used, the voltage of the two branches being 110. All the wiring throughout the building is installed in non-armored conduit, with the single exception of the flexible cables for the border lights on the stage.—*West. Elec.*, Dec. 15.

POWER.

Electricity in Machine Shops and Foundries.—JONES.—A long abstract of a paper read before the Am. Inst. Mech. Eng. For lathe driving the wide variation of speed required can best be obtained with direct current motors, with a multiple voltage system and with rheostatic control of the magnet coil current. For planers he recommends driving the countershaft in one direction continuously, and producing the reversals of the machine in the ordinary method common to mechanical driving. He recommends 220 volts for the majority of the motors, and 110 volts for arc and incandescent lamps. He gives the results of some tests of the power consumption of lathes, cranes and fans. A separate circuit must be used for at least the majority of the larger cranes and hoists; a separate lighting circuit is also required; also a machine-tool circuit for the lathes, drill presses, shapers, milling machines, etc. Regarding the advantages of individual motors over group driving he says that convenience of operation and the methods of securing the greatest amount of output from operating machinery by individual motors are of so much greater moment in most cases than economy of driving in pounds of coal saved, that the latter sinks into insignificance in comparison with the former. Regarding hoists he says that when the work to be lifted varies in weight from 75 to 500 lbs. the pneumatic hoist is believed to be generally the best. For a railway in the shop yards he recommends electric locomotives with the trolley system, or where this cannot be used, with accumulators or a surface contact system. For electric traveling cranes he says there is a need of fewer levers for controlling the different motions.—*Eng. News*, Dec. 13.

REFERENCES.

Water Power Plant at Chevres.—Continuations and conclusion of the illustrated description of the Chevres (Geneva) works (Digest, Nov. 17).—*Lond. Elec. Rev.*, Nov. 2, 16, Dec. 7.

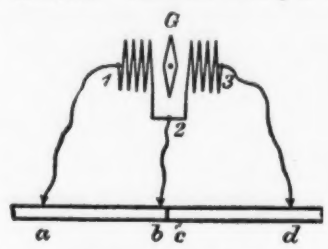
Water Power Plant at Snoqualmie Falls.—A very long and very well illustrated description of the water power plant and transmission system.—*Eng. News*, Dec. 13.

TRACTION.

Electric Traction on Main Lines.—LANGDON.—The conclusion of his illustrated Brit. Inst. Elec. Eng. paper on "The supersession of the steam by the electric locomotive," the first part of which was abstracted in the Digest Dec. 22. The result of his carefully made estimates regarding the special line which he considers, and mentioned in the first abstract, is that the cost of working by electricity as against that for steam locomotives is, per train-mile, as 14.04 to 17.89 cents, being an apparent saving of 3.85 cents per train-mile, or $1,300,775 on the average yearly cost for the 24 years considered by him. Were a new company to start with electricity as its motive power, it would not need to take into consideration the interest on the entire additional outlay, because it would save a great portion of it in other directions. But were an established company to adopt it, it would already have incurred the cost for the lands, buildings, etc., "and the expense for establishing electric working would unavoidably prove to it, for some years, an addition to its capital charges." In the discussion which followed and which is abstracted, the paper was highly appreciated; several speakers remarked that Langdon was even too moderate in his estimates and that the case for electric propulsion might have been made out even more favorably.—*Lond. Elec., Elec. Eng.*, Dec. 7; a reprint of the paper begins in Lond. *Elec. Rev.*, Dec. 7.

Electric Traction on Main Lines.—E. K. SCOTT.—He discusses the paper of Langdon and remarks: "It says much for electrical working that even Mr. Langdon's figures make out such a good case. It is certain that better figures can be given by adopting the three-phase throughout." He shows this, and says that punctuality is not the least of the advantages which would follow from the application of three-phase traction.—Lond. *Elec. Rev.*, Dec. 7.

Testing Rail Bonds.—An illustrated description of an apparatus of the General Electric Co. of Berlin. The principle may be seen from the adjoining figure, where *G* represents a differential galvanometer, *a b c d* a part of the rails with a bond at the point *b c*. First the wires 1 and 2 are connected to the points *a* and *b* of one rail; when there is a current in the rail, the needle of the galvanometer is deflected. Then the wire 3 is connected to that point *d* of the other rail, for which there is no deflection of the needle. In this case the resistances *a b* and *b d* are equal; *i. e.*, the resistance of the bond *b c* is equal to the difference of the resistances of the parts of the rails *a b* and *c d;* the resistance of the bond is therefore measured in lengths of rail.—*Elek. Zeit.*, Nov. 22.



TESTING RAIL BONDS.

International Tramway Congress.—Abstracts of the proceedings of this congress in Paris, which was held last September. The papers presented have already been noticed in the Digest. A number of questions were discussed, one of them being electric traction by accumulators, which included accounts of the disastrous experiences had by some of those who have persistently tried this system. A resolution was adopted to the effect that traction by accumulators had made no real progress and that this system ought to be used only under very extraordinary and unusual conditions.—*St. R'y Jour.*, Dec. 1; Int. Ed., Dec.

Berlin Tramways.—ROESSLER.—Continuations and conclusion of his very long report on the question whether the electric operation of the lines of the Great Berlin Tramway Co. satisfies the conditions of a regular and safe management corresponding to the present status of electrical engineering (Digest, Dec. 8). In these parts he continues to discuss the installation and operation of storage batteries in the tramcars. He further discusses the divisions of the lines of the mixed trolley and accumulator system into those on which the accumulators are charged, and those on which they are discharged. The greatest disadvantage of the mixed trolley and accumulator system is said to be the impossibility of charging the accumulators on those parts of the line which serve for this purpose, whenever the rails are covered with snow. He recommends using the trolley system on all straight streets and to limit the use of accumulators to only those short parts of lines where the overhead trolley wire is absolutely prohibited.—*Elek. Zeit.*, Nov. 22, 29, Dec. 6.

REFERENCES.

Storage Battery Cars.—ANDREAS.—A continuation of his serial (Digest, Dec. 15), giving detailed rules for mechanically placing and fixing a battery in an automobile or a tramcar.—*Centralblatt fuer Accum. und Elem. kunde.*, Dec. 1.

Automobile Exposition.—MAYER.—An article on a recent automobile exposition in Leipzig, Germany. The opinion is expressed that we will soon be able to run easily about 60 miles with an electric automobile without injuring the life of the battery.—*Centralblatt fuer Accum. und Elem. kunde.*, Dec. 1.

Philippines.—An article on prospects of trolley lines in the Philippines.—*St. R'y Rev.*, Dec. 15.

Wichita.—An illustrated article on the street railway system of Wichita, Kan.—*St. R'y Jour.*, Dec. 15.

Electric Railway in British Guiana.—SWAN and RANKIN.—A description of the trolley line of Georgetown, Demerara.—*St. R'y Rev.*, Dec. 15.

Great Britain.—A large table of statistics of the electric tramways and railways in the United Kingdom, with a large amount of information regarding their technical equipment and their finances.—Lond. *Elec. Rev.*, Dec. 7.

Austria and Hungary.—Statistical tables showing the traffic and receipts of the electric railways of Austria and Hungary from July to December, with comparative figures for 1899.—*Zeit. fuer Elek.*, Nov. 25.

REFERENCES.

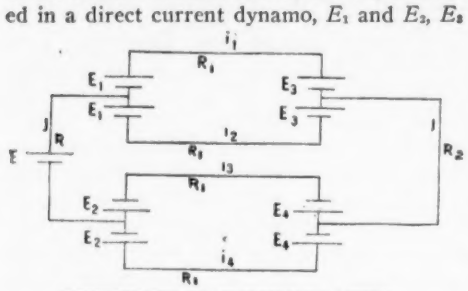
Brooklyn Navy Yard.—An illustrated description of the electric lighting and power plant of the Brooklyn Navy Yard. The capacity is 3600 kilowatts.—*Power*, Dec.

Crewe.—An illustrated description of the new municipal plant of Crewe. The three-wire direct current system is used with 460 volts between the outers. There are three steam-driven dynamos of together 475 kilowatts, and a battery having a capacity of 400 ampere-hours with a maximum rate of discharge of 180 amperes for two hours.—Lond. *Elec.*, Dec. 7.

Automatic Switches.—An illustrated description of the Allemann system of automatic switches for breaking and closing a circuit at predetermined times.—*Schweiz. Blaetter fuer Elek.*, Nov. 8.

Wires, Wiring and Conduits.

Saving of Copper in Transmission Lines.—Spielmann.—A communication referring to the recent paper of Bedell on the saving of copper by the transmission of alternating and direct current at the same time. He discusses the transmission scheme, illustrated in the adjoining figure. E, E_1, E_2, represent the e. m. fs. of the generators, r_1 the four transmission lines, E_3 and E_4 counter e. m. fs. in the receiving station; i the current, r resistance. He treats analytically the two following cases: First, E, E_1, E_2 are constant e. m. fs., *i. e.*, only direct current is transmitted; second, E is a constant e. m. f. generated in a direct current dynamo, E_1 and E_2, E_3 and E_4 are alternating; then he finds that if in both cases the same amount of energy is transmitted, the loss is also the same in both cases. Therefore, whether a part of the current is transmitted as alternating current or not does not effect the losses. He agrees that this connection of the lines enables one to save copper; for if the two systems were independent, twice as much copper would be required for the same currents and losses; but this saving of copper is due to the arrangement of the connections.—*Elek. Zeit.*, Nov. 29.



SCHEME FOR TRANSMISSION LINES.

Grounding of Low Potential Circuits and Electric Wiring.—Bathurst.—A communication in which he wishes to impress the fact that the Americans "are at last beginning to feel that it may be to their interest to veer round technically, so as to promote and encourage, rather than condemn, the earthing of the neutral wire for house wiring work." He thinks that electric wiring cannot be put on a commercial and scientific basis so as equally to suit all interests concerned, until it is allowed to insulate (properly) one rather than two wires. Experience is proving that perfect insulation implies perfect protection mechanically, electrically and chemically, while the steady growth of armored conduit systems points to the advantage of employing a metallic protection. He therefore concludes that some form of concentric system should be adopted in which a vital and inner conductor shall be protected by a suitable surrounding or outer conductor. In other words, "earthing," will have to be adopted ultimately, the broad question being, "how electric wiring work can be done efficiently and at a price."—Lond.*Elec.*, Dec. 7.

Free Wiring.—Kilgour.—A reprint of a report on different systems of "free wiring." He is strongly in favor of a system in which the municipal authority pays for the installation; the consumer is free to select his own contractor and to provide exactly what he desires in the way of an installation; he pays the capital cost, "together with the cost of the time accommodation," at fixed intervals spread over a term of years.—Lond. *Elec. Eng.*, Dec. 7.

REFERENCES.

Distributing Network.—Gillin.—A continuation of his illustrated article on "The arrangement of the distributing network" (Digest, Dec. 22). He discusses how to design a network so as to reduce to a minimum the number of consumers who would have their supply of electricity cut off in the event of the development of any fault on the system, and begins to discuss detailed arrangements for facilitating the localization of faults.—Lond. *Elec. Eng.*, Dec. 7.

Pipes for Carrying Wires.—Panamolo.—An illustrated article on pipes for carrying wires. He discusses defective joints; the use of old piping systems; bolts, nuts and connections; botch work; brackets; accumulations of foreign matter; cracked pipes and fires.—*West. Elec.*, Dec. 15.

Electro-Physics and Magnetism.

Cosmic Electrical Phenomena.—O. Lodge.—A communication on "Sun spots, magnetic storms, comet tails, atmospheric electricity and aurorae." "The whole subject of electricity demands reconsideration in the light of the facts now known concerning the existence of electrons, or at least of negatively charged corpuscles smaller than atoms. The old facts and theories remain true, but a step further can be taken, and a glorified electrostatics, that once despised subject, seems likely to dominate the field." He advances the suggestion that "electrons may be flung off the sun; or if they are scattered like meteors about space, that they are repelled by it, if it be a negatively charged body, as the cathode ray constituents are repelled by a cathode, describing therefore not elliptic, but hyperbolic orbits. If so, then in their flight past the earth they must act as an electric current, and therefore, unless they always surround it quite symmetrically, must occasionally deflect its magnetic needles. Furthermore, if they impinge on its atmosphere, they may electrify it." As they graze past the polar regions, they may in passing through the atmosphere give rise to the appearance not of a shower of meteors, but of the boreal and astral auroral. He briefly refers to the experiments of Cremieu (Digest, Dec. 22), whose view he does not accept.—Lond. *Elec.*, Dec. 7.

Electric Oscillations.—Fleming.—An abstract of the second of four Cantor lectures, the first of which was noticed in the Digest Dec. 22. He distinguishel between free and forced vibrations, dealt with the charge and discharge of Leyden jars and showed a series of experiments on synchronism. Possibly "expert tuners of electric circuits would rank as professional men with pianoforte tuners in the future. He also hinted that local authorities might succeed in distributing electrical energy through certain blocks of ether, and they would provide their consumers with apparatus tuned to receive the electric oscillations of the frequency which they dispatched." In order, however, to get resonance effects, the oscillations must persist. He thought the best possible results up to the present was a period of discharge in which oscillations set up lasted one-tenth of the time taken to charge the condenser. He finally dealt with recent progress in Marconi's wireless telegraphy (Digest, Oct. 27).—Lond. *Elec. Eng.*, Dec. 7.

Roentgen Ray Burns.—Isenthal.—A communication pointing out that in a recent case of a fatal effect of Roentgen rays the exposures were continued for two hours. To obtain a fair radiogram of a hip joint is a matter of a few minutes only; under such conditions he has never been able to produce any effect upon the skin whatsoever.—Lond. *Elec.*, Nov. 30.

Magnetic Field Due to a Moving Electric Charge.—Potier.—A communication in which he gives some critical theoretical notes on Cremieu's paper, noticed in the Digest Dec. 22. Unless there is strong proof to the contrary, he would not like to abandon the idea that a moving electric charge causes a magnetic field.—*L'Eclairage Elec.*, Dec. 1.

REFERENCES.

Alternating Currents.—Goldsborough.—Continuations of his illustrated serial. He gives the relations between e. m. f., current, resistance, reactance, and angle of phase, and defines the henry; he then gives the formula for the power consumed in an alternating current circuit.—*Elec. Rev.*, Dec. 5, 12.

Electric Force.—Pomey.—A mathematical note on the electric force per unit of surface in an electric field in a state of equilibrium.—*L'Eclairage Elec.*, Nov. 24.

Ions.—Lorentz.—An abstract of a theoretical paper on the apparent mass of ions.—*Phys. Zeit.*, Nov. 3.

Ions in Gases.—Stark.—A theoretical paper on the conduction of electricity through gases, dealing with a peculiar phenomenon in the migration of the ions; with free electrical charges recurring in the interior of the gas, and with the lines of force and the lines of current.—*Phys. Zeit.*, Dec. 1.

Electrocapillary Phenomena.—Gouy.—A French Academy note on the electrocapillarity of mixtures and the electrocapillary viscosity.—*L'Eclairage Elec.*, Dec. 1; abstracted in Lond. *Elec.*, Dec. 7.

Dissipation of Electricity in the Air.—Two papers, one by Elster, giving an account of measurements of the dissipation of electricity in the free atmosphere, made at several points in different countries; the other, by Geitel, on the dissipation of electricity in a space of air, separate from the atmosphere.—*Phys. Zeit.*, Nov. 24; both papers are briefly abstracted in Lond. *Elec.*, Dec. 7.

Roentgen Rays.—Sommerfield.—A theoretical article on the refraction of Roentgen rays.—*Phys. Zeit.*, Oct. 27.

Terrestrial Magnetism.—NIPPOLDT.—A long article giving a summary of the developments and our present knowledge of terrestrial magnetism.—*Phys. Zeit.*, Nov. 17, 24.

ELECTRO-CHEMISTRY AND BATTERIES.

Uniform Names for the Two Electrodes of Primary Cells and Storage Batteries.—KIRSTAEDTER.—To remove the general confusion in the use of the words "positive" and "negative" electrode, he recommends the following names: For primary and secondary batteries uniform names of the electrodes ought to be used; the electrode which is dissolved or the spongy lead electrode is called the "negative polelectrode; the depolarization electrode or the peroxyde electrode is called the "positive polelectrode." The words positive and negative refer therefore to the direction of the current in the external circuit. The term polelectrode is used in order to distinguish primary and secondary batteries, to which this term only applies, from an electrolytic bath, where the terms positive and negative electrode, or anode and cathode, refer to the direction of the current in the electrolyte. In an editorial note it is said that this nomenclature will be used throughout in future in that journal.—*Centralblatt. fuer Accum. und Elem. kunde,* Nov. 15.

Storage Battery.—ZACHARIAS.—An illustrated description of a new storage battery devised by Bary. The plates are made by machinery. The purpose is to get a maximum of active surface of Plante plates on a minimum space and with a minimum weight; this is accomplished by using a concentric arrangement of the electrodes, each electrode being built up of a great number of circular V-shaped troughs, one over the other. The battery is said to be highly interesting from a theoretical point of view, but to have inherent disadvantages which prevent its use in practice.—*Centralblatt. fuer Accum. und Elem. kunde,* Nov. 1.

Purifying Water by Ozone.—MARMIER and ABRAHAM.—An abstract of a paper read before the Internat. Soc'y of Elec. in Paris. First in the laboratory, and then in practice, they made experiments on the production of ozone and the purification of water by ozone. For the sterilization of water, the concentration of the ozone must be above a certain minimum which depends on the nature of the water and is in general 4 to 5 milligrams of ozone per liter of gas; the treatment of the water with the ozone must last at least a certain time; the contact between the ozone and the water must be as intimate as possible, because ozone is soluble in water only with difficulty. They describe the arrangement of their experiments. Their trial in practice in Lille has been very satisfactory. In general, the total cost of the process is 0.06 to 0.12 cent per cubic meter of water sterilized.—*L'Eclariage Elec.,* Nov. 24.

Calcium Carbide.—J. B. C. KERSHAW.—A continuation of his article (Digest, Dec. 15). He gives seven figures, obtained by experiments or estimates for the kilowatt-hours necessary to produce one metric ton of calcium carbide containing 80 per cent carbide; the values are between 4105 and 6514 kilowatt-hours. He then gives seven figures taken from actual working reports; they are between 3576 and 5960 kilowatt-hours.—Lond. *Elec.*, Dec. 7.

REFERENCES.

Storage Battery.—BROWN.—A paper read before the Peterborough Eng'ing Club. He describes different types of the storage battery, discusses briefly the chemical processes in the same, and gives an outline of the different commercial applications which it has found in electrical installations.—*Can. Elec. News,* Dec.

Bichromate Batteries.—DELL.—Some experiments with potash bichromate batteries used for induction coils, and some hints concerning their use. One of the difficulties was that the liquid did not act well when it got cold, and he seems to consider it necessary to warm it. (Many of the difficulties which he found would be overcome by using the bichromate of soda instead of potash, as it is much more soluble and does not crystallize so easily.)—*Elec. Rev.,* Dec. 5.

Commelin and Vian Storage Battery.—An article on this battery which was described in the Digest Oct. 6.—*L'Elec;* translated in *El'ty,* Dec. 12.

Potential of Silver.—THIEL.—A German Electrochemical Society paper, illustrated by numerous diagrams, on the potential of silver in mixtures of bromide of silver with a compound of rhodium and silver.—*Zeit. fuer Elektrochemie,* Nov. 15.

Bisulphate of Lead.—ELBS and FISCHER.—A paper on the production of bisulphate of lead by electrolysis of sulphuric acid between lead electrodes, and on some properties of bisulphate of lead.—*Zeit. fuer Elektrochemie,* Nov. 29.

Synthesis of Organic Substances.—ELBS and FOERSTER.—Some critical notes on the paper of Dony-Herault noticed in the Digest Sept. 1.—*Zeit. fuer Elektrochemie,* Nov. 29.

Reduction.—ROHDE.—A paper of a chemical nature, on the electrochemical reduction of certain special organic bodies.—*Zeit. fuer Elektrochemie,* Nov. 22, 29.

Benzidin.—LOEB.—A paper in which, after a theoretical introduction, he describes experiments with several electrolytic methods for the production of benzidin.—*Zeit. fuer Elektrochemie,* Nov. 22, 29.

Vortex Theory.—FRANK.—A speculative article on the theory of electrolysis and of cathode rays, from the standpoint of the atomic vortex theory.—*Electrochem. Zeit.,* Nov.

UNITS. MEASUREMENTS AND INSTRUMENTS.

High Tension Electrometer.—BAEUMLER.—An illustrated description of an electrometer devised by Ebert and Hoffman. There is an air condenser of very small capacity, consisting of two parallel metal plates, between which there is an ellipsoid of rotation made of aluminum, having a bifilar suspension; the longer main axis is inclined by 45 degs. to the direction of the perpendicular distance between the condenser plates. When the two condenser plates are connected to a source of e. m. f. the ellipsoid tends to assume the direction of the lines of force. The deviation of the ellipsoid is measured; it is proportional to the square of the e. m. f. The damping is accomplished by a copper cylinder mechanically connected with the ellipsoid, and moving in a strong magnetic field. He gives the tabulated results of some tests.—*Elek. Zeit.,* Dec. 6.

REFERENCES.

British National Physical Laboratory.—Reports, presented to the Royal Society on the work of the executive committee in the last year and to be undertaken in the coming year.—Lond. *Elec.*, Dec. 7.

New Compensator.—WILMSMORE.—An illustrated description of a new apparatus for measuring e. m. fs. by the Poggendorf compensation method.—*Elek. Zeit.,* Nov. 29.

Instruments.—TOBLER.—The first part of an illustrated serial on several new types of electric measuring instruments.—*Jour. Teleg.,* Nov. 25.

Bridge.—EDELMANN.—An illustrated description of reversible Wheatstone bridges of precision.—*Elek. Zeit.,* Nov. 22.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphone.—RUHMER.—An illustrated article on Poulsen's telegraphone. He describes a new arrangement for transmitting sounds spoken into a transmitter to a large number of receivers (telephone newspaper); also an improvement of the telegraphone consisting in introducing a cell and a variable resistance in the circuit of the recording electromagnets for polarizing the magnets; he also discusses some practical difficulties in the use of the instrument used as a long-distance recording telephone.—*Phys. Zeit.,* Nov. 24. The action of the polarizing cell is further discussed in *Phys. Zeit.* Dec. 1.

Telephone Relay.—SCHMIDT.—A communication in which he suggests a modification of Poulsen's arrangement of the telegraphone for using it as a telephone relay, by which weak telephone currents, when received, are increased for further transmission. He thinks he can apply it to long-distance telephony.—*Elek. Zeit.,* Dec. 6.

Insulated Telephone Wires.—WEST.—A brief communication pointing out several disadvantages in the use of insulated telephone wires, as suggested by Hackethal (Digest, Nov. 24). Such wires were used in Rome years ago, but without success, as the insulation was quickly deteriorated.—*Elek. Zeit.,* Nov. 29.

Telephone Switchboards.—CLAUSEN.—A continuation of his long illustrated serial (Digest, Dec. 1). He gives a description of the arrangement of a centralized battery system.—*Tel. Mag.,* Dec.

East Liberty.—An illustrated description of the independent telephone exchange of East Liberty, Pa.—*Elec. Rev.,* Dec. 12.

Block Signals.—KOHLFUERST.—Continuations and conclusion of his illustrated serial on automatic block signals for railways (Digest, Dec. 8). He deals with the systems of Ceradini, Krizik, Siemens & Halske and Basanta.—*Elek. Zeit.,* No. 22, 29, Dec. 6.

MISCELLANEOUS.

The Digest for 1900.—The year just closed was the eighth year of this department and is the last year during which it appears under the name of its founder, who started it in February, 1893, and has conducted it ever since, with the exception of a short period during the

summer of this year, during which it was conducted by his assistant. During the past year the number of issues abstracted was 1785, as compared with 1618 for the year before, or an average of over 34 per week; of these, 1051 were foreign, as compared with 852 the preceding year, and 734 were American. The number of abstracts and references was 3691, as compared with 3470 the previous year, averagain 71 per issue. The largest number in any one group was 586 under Traction; next comes Electro-Physics with 530, followed by Miscellaneous with 456.

REFERENCES.

Paris Exposition.—Gavey.—A reprint of his Brit. Inst. Elec. Eng. paper on telegraphs and telephones at the Exposition. (Digest, Dec. 15.)—*Tel. Mag.*, Dec.

An illustrated article on the large search lights of the Austrian Schuckert Works.—*Zeit. fuer Elek.*, Dec. 2.

Girault.—The conclusion of the long and well-illustrated description in detail of direct current machines exhibited by Schneider & Co. (Digest Dec. 15). This part deals with machines made in the Creusot Works.—*L'Ind. Elec.*, Nov. 10.

Soulier.—An illustrated description of an electric clock operated by polyphase current, devised by Thury.—*L'Ind. Elec.*, Nov. 25.

Bainville.—Illustrated descriptions of an automatic voltage regulator of Thury and of an electric clock of Thury.—*L'Elec.*, Nov. 10.

Loppe.—An illustrated description of a 825-kilovolt ampere three-phase alternator of Kolben, the voltage being 3000, the speed 94 r. p. m. Some information is also given about the central station of Prague (see the paper of Kolben, abstracted in the Digest, July 29).—*L'Elec.*, Nov. 17.

Bainville.—Illustrated descriptions of the Hansen arc lamp and the Heinz accumulator.—*L'Elec.*, Nov. 24.

Reyval.—Illustrated descriptions of the 3000-kilovolt ampere alternator of the Helios Company, of storage batteries of the Accum. Fabrik, Aktiengesellschaft, of Hagen, and of the Pescetto accumulator.—*L'Eclairage Elec.*, Nov. 10.-Illustrated descriptions of a 1000-kilovolt ampere 5000-volt alternator and a 350-kw 550-volt direct-current dynamo of Lahmeyer & Company, both direct connected to the same steam engine, running at 94 r. p. m.; also of an electro-hydraulic brake of Durey.—*L'Eclairage Elec.*, Nov. 3.-Illustrated descriptions of a 1000-kilovolt ampere three-phase alternator of the Internat. Elec. Company, of Liege (Pieper), the voltage being 2200, the speed 83.3 revolutions; also of a 450-kilovolt ampere three-phase alternator of the Gen. Elec. Company, of Nancy, the voltage being 3000, the speed 93.5 revolutions; also of electrically operated looms of the United Elec. Co., of Vienna.—*L'Eclairage Elec.*, Nov. 17.-Illustrated descriptions of a 1760-kilovolt ampere three-phase alternator of Brown, Boveri & Company, the voltage being 6000, the speed 83.5 revolutions; also of a 410-kilovolt ampere three-phase alternator of Brown, Boveri & Company, the voltage being 200, the speed 92.5 revolutions; also of a four-pole series wound 3-hp automobile motor of the United Electric Company, of Vienna.—*L'Eclairage Elec.*, Nov. 24.

Froitzheim.—A well-illustrated description of apparatus used in connection with the large Helios alternator.—*Elek. Zeit.*, Nov. 22. An illustrated description of the Helios alternator in *Zeit. fuer Elek.*, Nov. 18.

An article on electrochemical and metallurgical apparatus and new resistances, exhibited by Heraeus.—*Elek. Rund.*, Nov. 15.

An article on telegraphy, telephony and measuring instruments at the Exposition.—*Elek. Anz.*, Nov. 29, Dec. 2.

Illustrated descriptions of the 1529-kw direct current dynamo of Siemens Bros. & Co., the voltage being 550, the speed 200 revolutions. Also of a 1000-kw direct current dynamo of Siemens & Halske of Vienna, the voltage being 550, the speed 55 revolutions.—*Zeit. fuer Beleucht.*, Nov. 30.

An illustrated description of a 1000-kilovoltamp three-phase alternator of the Internat. Elec. Co. of Liege, the voltage being 2,200, the speed 83.3 r. p. m. Also of an electric relay used for distant distribution of the time for pneumatic clocks in Paris.—*L'Elec.*, Dec. 1.

Armagnat.—A long, well-illustrated description of measuring instruments in the German section.—*L'Eclairage Elec.*, Dec. 1.

Boucherot.—A well-illustrated description of his compound alternator (Digest, Oct. 27).—*L'Eclairage Elec.*, Dec. 1.

Reyval.—An illustrated article on the Kodolitsch electric riveter, exhibited by the United Electric Co. of Vienna.—*L'Eclairage Elec.*, Dec. 1.

An illustrated description of a 1000-kw 5000-volt three-phase alternator and a 350-kw 550-volt direct current dynamo, both driven by the same steam engine with 94 revolutions.—*Zeit. fuer Elek.*, Nov. 25.

Electro Arc Chromolume.—Bleyer.—An illustrated description of this apparatus, devised by him, which is a specially constructed arc lamp for generating violet rays of light, for therapeutic purposes, especially for cures of tuberculosis of the lungs.—*El'ty*, Dec. 12.

Metal Market.—Diagrams showing the fluctuations of the price of zinc, lead, iron, tin and copper during the month of November.—Lond. *Elec. Rev.*, Dec. 7.

New Books.

Cassell's Cyclopaedia of Mechanics. By Paul N. Hasluck. Cassell & Company, Ltd.: 384 pages, illustrated. Price, $2.50.

This handsome volume contains useful recipes, processes and memoranda in large quantity, freely illustrated by diagrams. The data given are very full and explicit, and are evidently derived from the experience of many practical men. The electrical apparatus is not very numerous, and might well be increased. There are many small pieces of electrical apparatus a handy man often likes to make for himself in these electrical days, but he needs to be told how. Possibly the editor does not include them under mechanics. The book is neatly bound and clearly printed in small type.

Electrochemische Uebungsaufgaben. Fuer das Praktikum sowie zum Selbsunterricht. Von Dr. Felix Oettel. Halle, A. S.: Wilhelm Knapp. 53 pages, 20 illustrations. Price, 3 marks.

This little book, in which a series of electrochemical laboratory experiments for students is given, appears to be of considerable educational value. The description of the arrangement of each experiment is brief and concise, and practical hints are given how to vary the experiment and how to use to advantage in practice the experience which has been acquired by performing the experiment.

After some introductory notes on the apparatus used in electrochemical investigations, methods are described for testing and calibrating the measuring instruments. Some fundamental electrochemical experiments follow, showing how the voltage of an electrolytic process depends upon the current density, the concentration, the temperature and the distance between the electrodes; further, how the electrolytic reactions occurring at the surface of the electrodes depend upon current density and concentration. Among the chapters accompanied by experimental illustration are those on electrolysis without and with diaphragm, electrodeposition of metals, the Siemens & Halske copper process, the Hoepfner copper process, electrolysis of fused salts, electrolytic methods applied in organic chemistry, etc. The value of a laboratory course in electro-chemistry cannot be overestimated, and in connection with such a course this book may prove to be of great value. The explanations and descriptions given in the same are, however, explicit enough to enable a student to use the book also to advantage for private study and experiments at home if he is acquainted with the theory of electro-chemistry and has at home the opportunity required for experimenting.

Directory of Electrical Societies, Etc.

Northwestern Electrical Association. Next meeting, Milwaukee, Wis., Jan. 16, 1901. (See "Current News and Notes" for more extended notice.)

Canadian Electrical Association. Next meeting, Ottawa, Ont., 1901.

American Street Railway Association. Next meeting, New York, October, 1901.

Northwestern Electrical Association. Next meeting, June, 1901.

National Electric Light Association. Next meeting, New York, 1901.

International Association of Municipal Electricians. Next meeting, Niagara Falls, N. Y., September, 1901.

Hot Wire Ammeters and Voltmeters.

The latest types of the well-known line of S. K. C. hot wire ammeters and voltmeters, first placed on the market two years ago by the Stanley Electric Manufacturing Company, embody a number of improvements which further enhance the accuracy and durability for which these instruments are noted. These instruments are of the Hartman & Braun type, and consist essentially of a short platinum silver wire, properly protected, and so arranged that its elongation

resultant from the heating effect of the current operates the pointer, which is delicately mounted in jewels. The instruments absorb but little current and are permanently correct, as is confirmed by a series of tests made in Germany by the Reichsanstalt, and by observations made here with instruments in service for a number of years.

The instruments are exceedingly robust but very light, and are insulated to stand a strain between the case and movement many times that which they would receive in practice. They are absolutely dead-beat, and therefore most desirable instruments for street railway work, for use in connection with synchronous motors, and for all other classes of work where the current or e. m. f. is subject to frequent or periodic fluctuations.

The scales of the instruments are very open and uniform throughout the working range. They are entirely non-inductive, and an instrument when calibrated for direct current is equally accurate on alternating current of any frequency or wave form. Another important feature is that the instruments are not affected by a surrounding magnetic field. They can be placed anywhere on a switchboard, or wherever most convenient, without regard to the proximity of conductors or generators.

Temperature error is eliminated by mounting the sensitive wire on a plate having the same coefficient of expansion as the wire itself. Readjustment is readily affected by bringing the pointer to zero. Means are provided outside the case to accomplish this and without disturbing the calibration.

FIG. 2.—AMMETER SHUNT.

In the case of ammeters only a small portion of the current measured passes through the hot wire, the main portion passing through a shunt of low resistance. For the switchboard type of instrument this shunt is external, and can be placed wherever most convenient. Figs. 1 and 2 illustrate two styles of shunts. This construction is often of importance, as it avoids the necessity of running heavy mains to the place where the instrument is located, thus effecting a saving in copper alone sufficient in some instances to pay for the total cost of the instrument.

By providing several shunts the same instrument can be used for widely differing currents. In some cases the instrument can be marked with several scales, or where the shunts are in direct ratio the proper scale can be provided for one shunt and the readings multiplied or divided, as the case may be, when other shunts are used. For example, by the use of one shunt, the full scale reading may be 3 amperes; substituting another shunt the full scale of the same instrument may be 3000 amperes.

In the ammeters for switchboard work the working parts are mounted on a hard rubber base in a rubber case with a plate-glass front. This secures the highest possible insulation between case and movement. The portable instrument is mounted in a polished oak case, provided with lock and key, and is very light—this latter condition being a most desirable one for a portable outfit.

FIG. 1.—AMMETER SHUNT.

Portable ammeters of 200 amperes or less capacity, and provided with only one range, have the shunt in the instrument case. Portable instruments designed for more than one range are provided with the necessary shunts mounted in a polished oak box and furnished with a pair of small leads for connection to the instrumnet. Such an instrument, for example, with shunts for 5—50—500 amperes, enables readings to be taken from 0 to 500 amperes on a finely graduated scale, either on direct or alternating current.

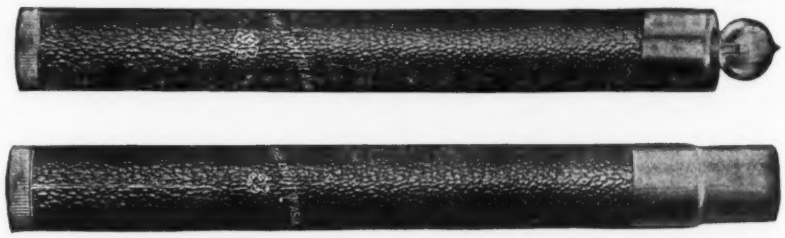
The switchboard voltmeters present the same general external appearance as the ammeters. Those reading up to and including 150 volts have their resistance mounted inside the case. External resistances are used with instruments of a higher voltage. A single hot wire voltmeter is capable of several different maximum voltages. This is especially advantageous as applied to the portable type, two or more resistances being carried in a separate box and enabling readings of any desired pressure of both direct and alternating circuits. The portable voltmeter is mounted in a wooden box similar in appearance to the portable ammeter.

FIG. 3.—HOT WIRE VOLTMETER.

"Light of Asia" Lamps.

The Electric Contract Company, 61 Elm Street, New York, has been remodeling its hand lamps with the result that at the present time it is offering three sizes of lamp. The smallest one has a diameter of only ⅞ in., is about 8 ins. long and weighs only ¼ lb. The shell is of aluminum, which is covered with a fine quality of leather. The latter gives the lamp a very handsome appearance, while the metal used contributes to its strength, making a very light parcel. The concern is now fitting these lamps with its own batteries, which are guaranteed for one year, each battery being dated. The battery will not run down while inactive, and maintains full power up to the moment of exhaustion.

The larger sizes of lamp are respectively 1¼ ins. in diameter, weighing 10 ounces; 1 9-16 ins. in diameter, weighing 20 ounces. The latter is about 9½ ins. The illustrations herewith show first the lamp when used as a candle with the incandescent lamp exposed. For a small lamp, the amount of light which the "Light of Asia" gives is little short of remarkable. The second illustration shows the same lamp with the candle protected by an aluminum shield which not only prevents the lamp from being broken off in its socket, but also acts as a reflector and concentrates a beam of light in one direction. The lamps are packed each in a neat case.



FIGS. 1 AND 2.—HAND LAMPS.

The use for these lamps has grown very materially in the past few years. They were originally looked upon as something in the nature of novelties, but have found their place in commercial affairs. They are especially handy for physicians in being called at night and entering darkened houses. The No. 1 lamp especially is so light that it may be easily carried in the vest pocket. The lamps are good for any service where there is a necessity for a brilliant light for a short period of time because of the absence of flame; they are safer than matches or candles, and there is never any danger of explosion from a gas leak. In fact, the larger sizes are exactly the sort of instrument which could be used to advantage in reading meters which are placed in dark cellars and which under ordinary circumstances are difficult of making out. We understand that they have, in fact, already been employed for such purposes.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was great activity in stocks last week and rapid advances in many securities are recorded. A bullish speculative movement began with the week, as a result of the bank statement of the previous week. It was more favorable than was expected and allayed the fears of a financial stringency. The public bought liberally, both for speculation and for investment, and many of the low-priced stocks sold higher. Industrial stocks were irregular, showing moderate strength in sympathy with the main shares. In the traction group the usual stories of combinations or of control of other properties by Metropolitan Street Railway Company exerted their influence and sent up these stocks. Brooklyn Rapid Transit was particularly active, the sales for the week aggregating 412,790 shares, the closing price representing a net gain of 8¼ points. Metropolitan Street Railway closed with an advance of 5½ points, the number of shares sold being 49,255. General Electric was very lively, the prices ranging between 199 and 171½, closing at 196, which is a net advance of 24¼ points. The dividend of $2 per share on the common stock, with the additional dividend of $1 per share, both payable on Jan. 15, will bring the total dividends for the current year up to $8 per share. In the money market there was an improvement in conditions, and much of the nervousness noted in last issue disappeared. Call money ranged between 4 and 6 per cent, the prevailing figures being 5@5½. The rates for time loans, with 40 per cent of industrials in the collaterals, were 5 per cent for 60 days and 4½ per cent for three to six months. Commercial paper was 4¾@5 per cent for prime double names. The irregularity in the market for outside securities as noted in last issue, continued, and toward the end of the week there was diminished trading, due largely to the holiday season. Among the most active industrials Electric Boat was prominent which stock had the sharpest advance of any. Much of the gain however, was subsequently lost. Closing stock quotations follow:

NEW YORK.

	Dec. 15.	Dec. 22.		Dec. 15.	Dec. 22.
Gen. Electric	171¾	196	Elec. Veh.	17	16
Bklyn. Rap. Tran.	75½	83¾	Elec. Veh., pfd.	35	35
Met. St. Ry.	168¾	174½	Gen. Car	4⅞	3¾
Am. Tel. & C.	—	—	Ill. Elec. Veh. Tran.	1	1
West. Un. Tel.	85½	83½	N.Y. Elec. Veh. Tran.	6½	6½
Am. Dist. Tel.	36½	—	N.E. Elec. Veh. Tran.	—	3
Com. Cable	—	—	Tel. & Tel. Co. of Am.	3⅛	2¼
Elec. Boat	26½	29	Hud. Riv. Tel.	115	115
Elec. Boat, pfd.	46½	49	N. Y. & N. J. Tel.	168	168

BOSTON.

	Dec. 15.	Dec. 22.		Dec. 15.	Dec. 22.
New Eng. Tel.	—	—	Erie Tel.	102	100
Mex. Tel.	2¼	2¾	Gen. Elec., pfd.	—	—
Westing. Elec.	54¼	55¾	Am. Tel. & Tel.	156½	155
Westing. Elec., pfd.	—	—	Ed. Elec. Lt.	—	—

PHILADELPHIA.

	Dec. 15.	Dec. 22.		Dec. 15.	Dec. 22.
Elec. Stor. Bat.	85	—	Phil. Elec.	4¾	4¾
Elec. Stor. Bat., pfd.	85	90	Pa. Elec. Veh.	—	3
Elec. Co. of Am.	8⅞	9	Pa. Elec. Veh., pfd.	—	1
Gen. Elec. Auto	¼	—	Am. Rys.	34¼	33⅝

CHICAGO.

	Dec. 15.	Dec. 22.		Dec. 15.	Dec. 22.
Chicago Edison	147	145	Chicago Telep. Co.	235	240
Chic. City Ry.	255	253	Union Traction	9½	11¼
Nat'l Carbon	16½	16¼	Union Traction, pfd.	42½	44½
Nat'l Carbon, pfd.	83	84½	Northwest Elev. Com.	29¼	29

* Asked.

AMERICAN BICYCLE COMPANY.—It is stated that net earnings are steadily improving, and 7 per cent should be earned on the preferred stock this year after liberal operating expenses and all interest charges. With such a showing the market values of the company's securities, it is contended, should be quoted at a higher level. Twenty-eight dollars per share for the preferred stock of an industrial company like the American Bicycle Company, earning $7 per share, is ridiculously and unwarrantably low. The bicycle business is by no means a thing of the past. The company sold 500,000 bicycles last year. Rapid development is being made in the automobile business. The company makes electric, steam and gasoline machines, and various agents throughout the country, who have heretofore only handled bicycles, are requesting information about automobiles, so that the future for this branch of the business is exceedingly bright. As stated last week, the company has taken over the Sperry automobile interests.

BROOKLYN RAPID TRANSIT.—Important developments in the affairs of the Brooklyn Rapid Transit Company will be soon announced. There are to be changes in the board of directors. New members to be elected will represent an influential banking interest and insiders of the Metropolitan Street Railway Company. Prominent directors of the Metropolitan Street Railway have acquired holdings of Brooklyn Rapid Transit stock sufficient, it is said, to control the property—with the co-operation of financiers already having large investments in the property. Messrs. Elkins and Widener and Thomas Dolan, of Philadelphia, with William C. Whitney and Thomas F. Ryan, of New York, have recently been buyers of Brooklyn Rapid Transit on a scale large enough to approximate a majority of the company's capital stock, and Mr. Ryan is believed now to be the largest stockholder of the Brooklyn company. There is, however, no indication of a consolidation of the properties, which might, on many grounds, be injudicious.

WESTINGHOUSE CAPITALIZATION.—The proposal to increase the capitalization of the Westinghouse Electric & Manufacturing Company has already been noted. The amount of such increase has not been determined; only the general policy of increase. Nearly all the stock is now owned in Pittsburg, Boston holding less than 20,000 shares. The capitalization of the company is now as follows: Three million two hundred thousand 5 per cent bonds, of which $150,000 bonds are cancelled each year; $4,000,000 7 per cent preferred stock and $11,000,000 common stock, now paying 6 per cent. Of the share capital about $400,000 remains in the treasury. The company is now employing about 6000 men and doing three times the amount of its former gross business. During the past two years the company's factory space and capacity has been doubled.

COMBINATION IN NEW JERSEY.—On Dec. 20 several electric light companies in the northern part of New Jersey were merged into the Central Electric Company, whose capital has been increased from $100,000 to $750,000. The companies merged are: The Raritan Electric Light & Power Company; the Bound Brook Electric Light, Heat & Power Company, the Dunellen Electric Light Company, the Edison Electric Illuminating Company of New Brunswick; the Railway Electric Company and the Middlesex Electric Company. The officers of the consolidated company are: President, Philip N. Jackson; vice-president, Adrian Riker; secretary, L. D. Howard Gilmour; treasurer, Uzal H. McCarter.

INTERNATIONAL TRACTION COMPANY.—Bartlett, Frazier & Company have issued a circular giving the main facts concerning the International Traction Company. The gross earnings of the company for the quarter ending Sept. 30 are given at $687,002 and the net profit after fixed charges at $161,390, the figures not including the Canadian route or bridges owned by the company. Attention is directed to the fact that at this rate the company can pay its bond interest and the 4 per cent on the preferred stock, and to the benefit the company will derive from the Pan-American Exposition at Buffalo.

MASSACHUSETTS ELECTRIC.—Activity and advance in Massachusetts Electric Companies common stock is the result of the contemplated issue of $2,700,000 4½ per cent five-year notes. The issue of these notes and the sale of Nashua Company stock places the Massachusetts Electric Companies in a position to pay off its floating debt and brings the common stock within sight of dividend, as this plan obviates necessity of keeping such large cash reserves. A dividend on Massachusetts Electric common stock in 1901 is regarded as a certainty.

MEXICAN TELEPHONE shows an increase in net for eight months of $12,073. The increased earnings are due to increased revenue now being received from the metallic system at $125 a year, while the cost of the old system of grounded circuit telephones was $75 a year. A large number of subscribers are substituting the new for the old system. The company refuses to accept any new subscribers for the old system. The total number of subscribers on Dec. 1 was 3,361, a gain of 406 compared with a year ago, and a gain of 296 since March 1.

TO SELL NEW HAVEN CAR LINES.—It is learned that arrangements have been perfected by the United Gas Improvement Company, of Philadelphia and New York for the purchase of the Fair Haven & Westville and the Winchester Avenue Street Railroad properties, New Haven, Conn. The price has been compromised at a little over 51. The option on the properties expires the first part of January, and it is understood that there is now no doubt as to the sale of the two roads. If purchased, the price will amount to more than $7,000,000.

MANHATTAN ELEVATED.—As to the saving to the Manhattan Elevated from the adoption of electricity, the estimate is that the road, which is now operating about 40,000,000 car miles a year, at a cost approximating 14 cents per car mile, will be able to operate under the new system at about 10 cents per car mile, which means a saving in operating cost of approximately $1,000,000 a year, which is 2 per cent on Manhattan stock.

CHICAGO UNION TRACTION has passed its quarterly dividend on the preferred stock.

CONSOLIDATION IN CANADA.—The deal between the Canadian General Electric Company, of Toronto, Ont., and the Royal Electric Company, of Montreal, Quebec, has been fully consummated, and from it the latter company will get upwards of $1,000,000 as the result of its disposal of its manufacturing plant. This deal means the establishment of a gigantic electrical manufacturing combination in Canada with a capital of $60,000,000 at its back. The General Electric Company will in future carry on the manufacturing business formerly done by the Royal, while the latter company will confine itself to supplying light and power locally on an extensive scale. The Royal Company contemplates making large expenditures for improvements, and among other things will begin putting its wires underground at the opening of spring. It is estimated that the cost of this work will probably exceed $1,000,000. In connection with this deal, also, the union of all the lighting companies in the city of Montreal is contemplated, the first move of which will probably be the association of the Montreal Gas and the Royal Electric companies.

DIVIDENDS.—At a meeting of the executive committee of the Erie Telegraph & Telephone Company, the Michigan and the Wisconsin Telephone Companies, it was voted to recommend to directors that a regular quarterly dividend of 1¼ per cent be declared by the Erie and Michigan companies and a dividend of 1¾ per cent declared by Wisconsin Telephone Company, all payable Jan. 14. The Cincinnati Edison Electric Company has declared a dividend of 1¼ per cent, payable Jan. 2. The Findlay (Ohio) Street Railway Company has declared a dividend of ¾ of 1 per cent, payable Jan. 10. Directors of the American Telegraph & Telephone Company have declared a regular quarterly dividend of 1½ per cent and ¾ per cent extra. The Boston Electric Light Company has declared a regular quarterly dividend of 2 per cent, payable Jan. 15 to stockholders of record Jan. 1. Directors of the General Electric Company have declared the regular semi-annual dividend of $3.50 per share, payable Jan. 31, on the preferred stock. The directors of the American Stoker Company have declared a quarterly dividend of 2 per cent on the preferred stock.

CONSOLIDATION IN YOUNGSTOWN.—The electric light and street railway properties in this section, which have been acquired during the past three months by the Devitt-Penhale syndicate, have been consolidated under the title of the Youngstown & Sharon Railway & Lighting Company. The organization was perfected at a meeting, held in New York recently, and the company has been incorporated, with a capital stock of $2,500,000, under the laws of New Jersey The consolidated properties include the following: Youngstown & Sharon Railway Company, Sharon & Wheatland Railway Company, Youngstown Consolidated Gas & Electric Lighting Company, Valley Electric Street Railway Company and the Sharpsville Electric Lighting Company. Hon. R. Montgomery has been elected president of the controlling company, but the other officers have not yet been announced.

CONSOLIDATED EQUIPMENT.—A company has been formed in London to develop in Europe the patents of the Consolidated Railway Electric Lighting & Equipment Company. It was announced last week that Isaac L. Rice, president of the company, had completed negotiations through which Vicker Sons & Maxim, of England, will undertake the introduction in Europe of the appliances of the Consolidated Company. It is claimed that the company's system of car lighting is superior to any system now in use in Europe, and the company expects to establish a large business in England and on the Continent. Friends of the company state that the success that its system has already met with in this country assures success abroad, and they claim that the contract which has just been made will result in very substantial benefit to the company.

EXTENSIONS IN BIRMINGHAM, ALA.—The stockholders of the Birmingham Railway, Light & Power Company, which recently absorbed the Birmingham Railway & Electric Company, the Birmingham Traction Company and the Birmingham & Powderly Railroad, thus getting control of all the street car lines as well as all electric light and power of the city, has voted for an issue of $3,500,000 of 50-year 5 per cent bonds. Half of the issue will be devoted to taking up or indemnifying present bond issues on the various absorbed companies, and the remainder will be used in extending the company's lines and making other improvements.

ELECTRIC BOAT.—At a meeting of the board of directors, held last week, it was decided to call the amounts on the original subscriptions to the stock of the Electric Boat Company which still remain unpaid. Originally 25 per cent was paid on the subscriptions the balance being left to be paid as called by the directors. Many large holders of the stock have since voluntarily paid the full amount due on their subscriptions, so that the present call affects but a small part of the company's stock. The payment is to be made in three installments of 25 per cent each, due Jan. 3, Jan. 15 and Jan. 25.

ERIE TELEGRAPH & TELEPHONE.—The Erie Telegraph & Telephone Company, to provide funds for the subsidiary companies to pay cost of extensions and additions to properties, offers stockholders of record Dec. 31 the right to subscribe for 50,000 shares of treasury stock, at par; one-half share for each share now owned. Subscription expires Jan. 7. Stock not taken by stockholders will be sold to underwriters.

METROPOLITAN.—Metropolitan (N. Y.) Street Railway directors have decied to issue to stockholders $7,000,000 of treasury stock at 160. A circular, giving definite terms and times of payment, will be issued soon. The proceeds of this stock will be used to pay off the floating debt incurred for the Third Avenue purchase and in the reconstruction of part of the system with the underground trolley.

PACIFIC CABLE COPPER.—James Lewis & Sons, of Liverpool, say: "A tender of £1,795,000 has been accepted for the Pacific cable to be completed in two years. The length is 8,800 miles and the quantity of copper required for it is estimated at about 4000 tons."

Commercial Intelligence.

THE WEEK IN TRADE.—Reports from all parts of the country indicate favorable conditions of trade, holiday business being particularly brisk, largely on account of the seasonable weather. Western jobbers are cheerful, reporting collections good. In wholesale lines, however, quietness prevails, a condition usual at this season. Particularly good reports are made from the iron and steel and hardware trades. Current gross railway earnings equal, if they do not excel, those of last year at the same time, although some decrease might naturally be expected. Net earnings of railroads, as a whole, however, are smaller than last year, because the decreases, due to the coal strike are now in evidence. In structural material, an immense amount of business is still being placed, and specifications are coming forward freely. Export trade is quieter and there are cabled reports of shutdowns of Scotch iron producers. The other metals are steady. Little was done in copper, and prices remain unchanged, Lake Superior ingot being quoted at 17c., and electrolytic and casting stock at 16⅝c. In the machinery market there is a stronger tone, the volume of business being about normal. One of the largest contracts engine builders have been called upon to consider is that for five 4000-hp engines for a new power house which, it is reported, the Brooklyn Rapid Transit Company intends to build. It is stated that the Transit Company may find difficulty in getting the engines in time on account of the numer ous orders the large builders now have in hand. The business failures for the week, as reported by *Bradstreet's*, number 262, as against 247 the week previous, and 211 the same week last year.

NEW ALLIS ENGINE WORKS.—The E. P. Allis Company has announced that it has closed contracts for the purchase of a 100-acre tract of land near Wauwatosa, five miles west of Milwaukee, and will build a mammoth new plant there to which its present local shops and also those at Buffalo will be moved. The general superintendent of the company, Edwin Reynolds, said that as soon as the buildings can be erected, arrangements for moving from Buffalo to this city would be begun, but that he thought it would be a year before the works at Buffalo could be closed. There are 500 employes in the Buffalo plant. Plans for the building are not fully decided upon, but sketches in the hands of Mr. Reynolds, show a foundry 210 feet wide and 1000 feet in length, with open space behind for an additional 1200-foot building. The machine shop, as shown, is 120 feet wide and 600 feet long, and there will be four of these, all of the same dimensions. All will be connected with the erecting shop, 110 feet wide and 1000 feet long, with sufficient ground behind it to make it whatever length business demands. The entire site under consideration in Wauwatosa covers a length of 2640 feet and a width of 1650 feet. Five railroad tracks run into the shop, each track covered with three traveling cranes to be used for loading and unloading. The plant will consume five years in building and the amount the company will probably invest is estimated at $2,000,000.

EXPORTS OF ELECTRICAL MATERIAL.—The following were exports of electrical and kindred materials from the port of New York for the week ended Dec. 13: Antwerp—26 cases electrical machinery, $4,000. Argentine Republic—87 packages electrical material, $3,534; 7 cases electrical machinery, $1,819. British East Indies—12 cases electrical material, $203; 6479 packages electrical railroad material, $118,500; 14 cases electrical machinery, $5,000. Bremen—1 case electrical material, $352. British Possessions in Africa—81 packages electrical material, $8,266. Barcelona—2 cases electrical material, $63. Berwick—4 cases electrical material, $288. Brazil—27 packages electrical material, $1,303; 9 packages electrical railroad material, $1,091. British Australia—62 packages electrical material, $8,749; 2 cases electrical machinery, $126. British West Indies—701 packages electrical material, $1,382. Central America—194 packages electrical material, $796. Christiania—34 packages electrical machinery, $4,622. Cuba—197 cases electrical material, $7,938; 1 elevator, $290. Dundee—10 boxes electrical machinery, $950. Ecuador—25 packages electrical machinery, $1,009. Elberfeld—1 package electrical material, $3. Frankfort—4 packages electrical material, $300. Glasgow

—77 packages electrical material, $2,452; 51 reels electric cable, $21,-507. Genoa—276 packages electrical material, $25,726. Hull—60 packages electrical material, $17,824. Havre—23 packages electrical material, $929. Huddersfield—2 cases electrical material, $92. Hamburg—3 packages electrical machinery, $1,600; 84 packages electrical material, $4,195. Liverpool—303 packages electrical material, $22,-368; 25 packages electrical machinery, $5,525. London—118 packages electrical material, $1,633; 9 cases electrical machinery, $1,696. Manchester—275 packages electrical material, $37,815; 1 case electrical machinery, $389. Mexico—270 packages electrical material, $2,772; 15 cases electrical machinery, $525. Milan—17 packages electrical material, $1,910. Newcastle—34 packages electrical material, $5,695; 35 cases electrical machinery, $3,500. Odessa—1 package electrical material, $14. Porto Rico—92 packages electrical material, $2,166. Peru—4 packages electrical material, $105. Preston—2 cases electrical material, $41. Rome—1 case electrical material, $17. Southampton—4 cases electrical material, $195. St. Petersburg—8 cases electrical material, $1,584. United States of Colombia—6 cases electrical material, $151; 1 case electrical machinery, $51. Venezuela—10 packages electrical material, $149. The following is a list of the exports of electrical material and kindred lines from the port of New York, for the week ended Dec. 20: Antwerp—38 packages electrical material, $737; 180 packages gas radiators, $1,362. Amsterdam—2 packages electrical material, $10. British East Indies—8 cases electrical material, $302. Brazil—24 packages electrical supplies, $913. Barcelona—13 packages electrical material, $1,230. Bristol—1 case electrical material, $104. British Australia—15 packages electrical material, $1,014. Central America—49 packages electrical material, $3,056. Cuba—28 packages electrical material, $599. Dutch West Indies—3 packages electrical material, $76. Dutch East Indies—2 cases electrical material, $57. Glasgow—7654 packages electrical cables and supplies, $16,084; 53 packages electrical material, $9,451 Genoa—332 packages electrical material, $29,098. Geneva—85 packages electrical material, $910. Hongkong—95 packages electrical material, $12,247. Hamburg—1 package electrical machinery, $1,965; 26 packages electrical material, $1,066. Havre—36 packages electrical material, $275; 1 case motors, $4,075; 27 cases electrical machinery, $10,000. Japan—81 packages electrical material, $9,621; 29 cases electrical machinery, $10,472; 37 packages motors, $4,849. Korea—8 cases electrical material, $524; 14 packages electrical machinery, $6,440 Liverpool—18 cases electrical material, $1,385; 56 cases electrical machinery, $10,171. London—120 packages electrical machinery, $12,603; 233 packages electrical material, $11,592. Manchester—47 packages electrical material, $7,300. Mexico—31 packages electrical material $655. Marseilles—11 packages electrical material, $1,652. Milan—3 cases electrical material, $200. Naples—38 cases electrical material, $600. Newcastle—22 packages electrical machinery, $2,000. New Zealand—7 packages electrical material, $75. Philippines—56 packages electrical material, $2,298; 17 packages electrical machinery, $5,862. St. Petersburg—1 package electrical material, $150. San Domingo—236 packages electrical material, $1,541. Southampton—6[illegible] packages electrical material, $4,397. Tasmania—5 cases electrical material, $26. Venezuela—54 cases electrical material, $3761.

OTTO GAS ENGINE WORKS.—For many months past the management of the Otto Gas Engine Works, Philadelphia, has been planning to very materially increase the size and the capacity of its plant. The result of the recent election has confirmed the company, it states in its belief that the present is an opportune time to consummate its plans and make the contemplated improvements. The entire block upon which the present shops stand has been acquired and contracts have been let for two brick buildings, which will increase the floor space some 12,000 feet. Orders have been placed for tools of both standard and special designs, and when all is completed it is believed that the capacity of the works will be fully doubled. The estimated cost of these additions is $100,000, and they are made necessary by the fact that at no time during the last two years has the company been able to take care of the business that has offered. Moreover, the new lines of stationary and marine engines of large power that have been recently added, call for heavier and a greater variety of tools than any which the business has hitherto required. With almost enough business in sight to keep the enlarged factory running for the next twelve months, the wisdom of the company's course seems assured.

EXPORTS AND IMPORTS.—The commercial record of the United States in the calendar year 1900 will surpass that of any preceding year, both in exports and in the excess of exports over imports, or "favorable balance of trade," as this excess is usually termed. The imports will be slightly below those of one or two preceding years, and when considered in their relation to population show a smaller importation for each individual than at almost any other period in many years. Basing the estimate for the year upon the eleven months' actual figures already received by the Treasury Bureau of Statistics, it seems probable that the exports of the calendar year 1900 will reach about $1,470,000,000, and the imports $825,-000,000, making the excess of exports over imports, or favorable balance of trade, $645,000,000, a sum greater by $25,000,000 than that of any preceding year. It is only since 1873 that the exports have with any regularity exceeded the imports or produced the favorable commerce during the last quarter of a century. Yet it remained for the closing year of the century to present not only the highest figures of exports, but the highest record of excess of exports over imports, or favorable balance of trade in the history of our commerce.

RECENT CROCKER-WHEELER ORDERS.—In addition to the other orders noted lately in these columns, the Crocker-Wheeler Company announces contracts for generators from the United States Mint at Philadelphia and the Government Printing Office, Washington; also for League Island Navy Yard. Generators have also been sold to Frick Engine Company; Arlington, (N. J.) Copper Company; Abraham & Strauss, Brooklyn; A. Booth & Company, Chicago; Arlington Hotel, Washington; Richmond Locomotive Works; Lehigh Valley Railroad; Hadaway Electric Heating & Engineering Company; Keuffel & Esser; Hotel Earlington, N. Y.; Child's Unique Dairy, N. Y.; Newark Public Library; State Capitol, Trenton; New Jersey State Reformatory, etc. The company has also sold railway generators to the Cumberland Valley, (Pa.) Traction Company, and the Ohio Railway & Power Company. In addition, orders have been taken for 66 motors, totaling 300 horse-power, for the mint, and 35 motors, total 400 horse-power, for the Toledo (Ohio) Bridge Company. The American Bridge Company has also added to the Crocker-Wheeler equipment at its Pencoyd works.

AMERICAN ROLLER-BEARING COMPANY.—Mr. Myron Francis Hill, president of this company, reports some very interesting developments due to his trip abroad. He states that they have been taking up the protection of their patents in all the principal countries of the world. In Germany the case was rejected. He went to Berlin, and after a long hearing with their German agent before the Board of Appeals, the patent was unanimously allowed. After a short time in Holland, he proceeded to London and arranged there for the European branch. The head of the company is Mr. Leonard W. Holmes. well known in the United States, member of J. H. Holmes & Company, the electrical firm, and chairman of the Johnson-Lundell Motor Traction Company in England. The directorate will be made up of men of high standing in English engineering and manufacturing. At first the product sold will go from the Boston factory, but as soon as possible a factory will be started in England, equipped and organized on American plans. This will supply bearings for the English market.

STRUCTURAL STEEL.—A special dispatch from New Haven. of Dec. 21, says: "It is announced that three of the best-known directors of the Berlin Iron Bridge Company have withdrawn from the company and are to establish a rival concern at Kensington, occupying the old Yale Brick Company's plant. The incorporators of the new company are D. E. Bradley and George H. Sage, of Berlin, and Seymour N. Robinson, of New York City. The new company will ask for incorporation rights at the coming Legislature, and will start their factory early in the year. The new company will take contracts for river and railroad bridges and will be represented abroad.

CHANGE IN THE CUTTER COMPANY.—On Dec. 15 Mr. Henry B. Cutter resigned from the Cutter Company, of Philadelphia his interest in the business established by him having been purchased by other interests represented by A. Edward Newton and William M. Scott. Mr. Newton, who assumed the financial management of the company five years ago, has been elected president; Mr. Scott, who has been the chief engineer and the patentee of the apparatus manufactured by the company, has been elected vice-president and general manager. It is understood that Mr. Cutter will retire from active business

THE H. W. JOHNS MANUFACTURING COMPANY is at work on the twenty-story Broad-Exchange Building, corner of Broad Street and Exchange Place, New York, applying its asbestos covering The riser pipes alone require over 40,000 feet of covering, and when the pipes are all covered there will be put on between 50,000 and 60,000 feet. This is one of the largest buildings recently erected in that section of the city. The H. W. Johns Manufacturing Company issues a very complete illustrated list of its various asbestos coverings. It can be obtained on application.

MR. Y. WATANABE, architect for the Imperial Japanese Navy has contracted with the American Bridge Company for the steel work for a foundry and a gun and mounting shop for the Kure Arsenal. The American Bridge Company is also furnishing steel work for the forge shop for the Kure Arsenal. It has also a contract to furnish the Compagnie des Chemins de Fer de Porto Rico with two 133-foot spans for the Manati River Bridge, in that island.

NEW MACHINERY FOR AUSTIN.—Mr. H. C. Patterson, superintendent of the municipal water works and electrical plant of Austin, Tex., has been in Pittsburg and other eastern cities for the past several weeks placing orders for additional machinery for the steam-electric light and power plant at Austin.

STEEL FOR DYNAMOS.—The Bethlehem Steel Company reports that a contract has been closed with the General Electric Company for six weldless field rings of Bethlehem nickel steel for the extension to the power plant at Niagara Falls.

General News.

THE TELEPHONE.

WAXHAW, N. C.—The Waxhaw Telephone Company has been incorporated.

LEIPSIC, OHIO.—The American Electric Telephone Company is installing a new switchboard at the exchange of the Home Telephone Company.

SEDALIA, MO.—The Missouri & Kansas Telephone Company has announced that after Jan. 1 it will reduce the price of residence telephones in this city.

DETROIT, MICH.—Mr. J. W. Martin has appeared before the city council asking for an ordinance providing a franchise for independent service in this city.

ST. CHARLES, MO.—The Kinloch Telephone Company has closed a deal whereby the independent exchange of John Enoch and sixteen-year franchise have become its property.

LEXINGTON, KY.—All the telephone wires in this city are to be laid in conduits. The company to do the work is called the Fayette Telephone Company. Terra cotta conduits are to be used.

NASHVILLE, TENN.—The Citizens' Telephone & Construction Company has been chartered, with capital stock of $10,000, by H. A. Campbell, W. H. Wiggerman, A. W. McMackin and others.

ERIE TELEPHONE.—Vice-President Pettengill, of the Erie Telephone system, who has just returned from Texas, says: "There is no truth in the report of a threatened strike on the Erie system."

WARREN, OHIO.—E. G. Miller has been appointed manager of the Warren exchange of the Warren-Niles Telephone Company, succeeding E. J. Clapp, who goes to a new company at Aurora, Ill.

BALTIMORE, MD.—The Maryland Telephone Company is now engaged in substituting new instruments for those used by the subscribers of the old Home Telephone Company. The Home Company had 1300 instruments in use.

AUSTIN, TEX.—The City Council of Austin has granted a franchise to J. B. Earle, of Waco, and associates, for an independent telephone system in Austin. The new company binds itself to expend not less than $100,000 in the work.

MINERAL RIDGE, OHIO.—The Central District Printing & Telegraph Company (Bell) has failed for a third time to secure a franchise for a local exchange. The village authorities are well satisfied with the independent company.

PORTLAND, ME.—The telephone war which has existed in this city since last spring between the Dirigo Telephone Company and the Eastern Telephone Company has been settled. The aldermen voted not to admit either company into the city.

COLUMBUS, IND.—H. O. Butler, for several years manager and chief stockholder of the Citizens' Telephone Company, has sold his stock to Hon. S. P. Sherin, of Indianapolis. Max Hosea, chief lineman, will succeed Mr. Butler as manager.

THE NORTHWESTERN TELEPHONE & TELEGRAPH COMPANY, of Carthage, N. Y., to construct and operate telephone, telegraph, electric light and power plants, with a capital of $2,000,000, was incorporated at Wilmington, Del., last week.

ZANESVILLE, OHIO.—The Ohio Telephone & Telegraph Company is installing a new long-distance board at the Central Union Company's exchange. Two new lines will be built to Cambridge and a new line to Sego, Mt. Perry and Somerset.

MILTON, WIS.—C. W. Crumb, B. H. Wills, J. H. Owen and J. A. Paul are the incorporators of a company just organized to build a telephone exchange for the villages of Milton and Milton Junction. Contracts have been signed for 50 subscribers.

RAVENNA, OHIO.—The United States Telephone Company has placed a new toll switchboard in the exchange of the Ravenna Home Telephone Company. It has double the capacity of the old one and gives improved service to Cleveland and other points.

CLEVELAND, OHIO.—Local representatives of the American Federation of Labor are endeavoring to form a union among the telephone operators in this city, about 400 in number. Both the Cleveland and the Cuyahoga companies do not favor unions among their employees.

BOSTON, MASS.—The Massachusetts Telephone & Telegraph Company has commenced to furnish its subscribers with a limited local telephone service. Cables are being connected with the company's main switchboard on Franklin Street, and the service is rapidly being extended.

AKRON, OHIO.—The Akron People's Telephone Company has increased its capital stock from $100,000 to $500,000. The company will enlarge its switchboard and will install branch exchanges at Cuyahoga Falls and Barberton. The Stromberg-Carlson Company has the contract for switchboards.

NEWARK, OHIO.—The Newark Independent Telephone Company, which now has connection with the new exchange at Columbus, Ohio, has arranged to connect with 172 miles of toll lines in Muskingum, Holmes and Coshocton Counties and the exchanges at Frazeysburg, Warsaw and Bloomfield.

WAUSAU, WIS.—The citizens of the city of Edgar have organized a home telephone company and will put in an exchange with 25 subscribers. They will connect with the lines of the Marathon County Telephone Company, which in turn connects with the Wood County and Little Wolf River companies.

ALLIANCE, OHIO.—The Stark County Telephone Company, promoted by S. C. Thayer, of the Columbiana County Telephone Company, has secured a franchise after one of the hardest fights recorded in the history of independent telephone companies in Ohio. Twice in eight months the franchise was refused.

SPENCER, IND.—The People's Free Telephone Company has been organized at this place, and has made an arrangement to open an exchange. Both day and night service will be given. There are now about 600 telephones on the line. Dr. S. N. Quinlin is at the head of the committee of managers. How the plant is to be maintained is not stated.

MARSHFIELD, WIS.—This city is now in telephonic connection with all the important cities of Central Wisconsin. Two independent lines are completed now. The Wood County Telephone line began business on Dec. 13. The Marathon County line from Wausau opens up a territory as far north and east as Rhinelander.

AUSTIN, TEX.—Although there has been no settlement of the strike of the employees of the Southwestern Telegraph & Telephone Company in the several Texas cities, the local exchanges and toll lines of the company are being operated with occasional and slight interruptions, the places of the strikers having all been filled with non-union operators and linemen. Several members of the Electrical Workers' Union at San Antonio have been arrested on indictments charging them with assault to murder, their intended victim being a non-union employee of the Southwestern Telegraph & Telephone Company.

ELECTRIC LIGHT AND POWER.

ARKADELPHIA, ARK.—Albert Moore and associates have been granted an electric light franchise.

PRATT CITY, ALA.—The city is reported as contemplating the construction of an electric light plant.

ALTON, ILL.—The Alton Electric & Illuminating Company is installing a 650-hp generator in its power house.

ASHLAND, KY.—The Ohio Valley Electric Company contemplates the expenditure of $200,000 in improving its plant.

WAYNESVILLE, OHIO.—The village authorities have let contracts for the construction and equipment of a municipal electric lighting plant and water works.

BRISTOL, TENN.—The Bristol Light & Power Company has been incorporated, with capital stock of $25,000, by E. J. Sanford, B. L. Dulaney, John Caldwell and others.

DAYTON, OHIO.—The city will build a large central market house which will be equipped with electric lighting plant and a refrigerating plant. H. N. Reynolds is preparing plans.

ALBANY, N. Y.—The Hamburg Electric Land Company, of Buffalo, has been incorporated; capital, $7,770. Directors: Lewis J. Heints and A. J. Ross, Buffalo; Lorasso Fields, Rochester.

ELROY, WIS.—Edward S. Wesley, of this place, and Ernest Buck, superintendent of the Elroy Municipal Electric Light & Water Plant, have purchased the electric light plant at Ellsworth and it will be improved.

LIMA, OHIO.—Arthur L. White has made application for a franchise to construct and operate an electric light and power system. He will make an effort to secure the municipal lighting contract now held by the Lima Electric Light & Power Company.

STEUBENVILLE, OHIO.—A new company, headed by W. S. McCauslen, has applied for a franchise to construct and operate an electric lighting and power plant. The company agrees to illuminate all public buildings, school houses, engine houses, etc., free of charge.

THORNTON, IND.—Work on the power house for the new electric light plant is under way. R. S. Ashe, of Indianapolis, has the contract for the electrical equipment, and W. J. Jester, of this city, is building the power house. J. B. Nelson, consulting engineer, of Indianapolis, designed the plant.

KNIGHTSTOWN, IND.—This city is preparing to purchase and operate the electric light plant in the near future. The plant is now owned and operated by private parties and has been offered to the city at a price that has aroused the spirit of municipal ownership.

ROSEBURG, ORE.—Roseburg will have another electric light plant. It will be installed under the direction of L. A. Walker, formerly in charge of the Roseburg Light & Power Company's plant. Work will commence as soon as possible and it is expected the plant will be completed by April 1.

SPRINGFIELD, OHIO.—The Springfield Light & Power Company has declined to materially lower the price for arc lighting, and the city officials have about decided to make a contract for one year, at the expiration of which time the new Citizens' Lighting Company, which is being organized, will be given an opportunity to bid.

CINCINNATI, OHIO.—The property of the Suburban Electric Company, of Covington, was sold at public sale to a syndicate of Eastern bondholders, representing $200,000 worth of the bonds, for $181,000. It is claimed that the Edison Electric Company, of Cincinnati, a competitor for Cincinnati municipal lighting, is behind the purchase.

NORTH MILWAUKEE, WIS.—The North Milwaukee Electric Light Company has been incorporated by A. D. Miselbach, Otto Brandis and John H. Hurley, to take charge of the electric lighting business in the village. The capital stock is $15,000. The plant has been in operation for some time, but was controlled by a manufacturing company.

SPRINGFIELD, OHIO.—The city fathers are in a state of suspense over trouble in the renewal of the contract for lighting the city. An equal division of opinion as to the price to be paid to the Springfield Electric Light & Power Company has caused a deadlock that has existed several weeks. The price of the company has been fought down from $89 per arc light per annum to $75 per light, and two or three members of the council persist in even a greater reduction.

RALEIGH, N. C.—The Raleigh Ice & Electric Company expects to have completed by March 1, 1901, its big electric plant at Milburnie, some distance from Raleigh. The dam will be 470 ft. long. The contract for four 45-in. centre discharge turbine wheels has been let to the James Leffel Company, Springfield, Ohio, and the contract for the electrical outfit to the Westinghouse Electric & Manufacturing Company, Pittsburg. The entire plant was designed and is being erected by Messrs. Eberhardt & Hillyer.

THE ELECTRIC RAILWAY.

CLEVELAND, OHIO.—The Portage Lakes Traction Company has completed the work of securing the rights of way.

ANN ARBOR, MICH.—Another franchise for an electric railway from this city to Detroit has been asked for. The promotor is Dr. W. W. Nichols.

FINDLAY, OHIO.—The Findlay Street Railway Company will extend its road north from Mortimer to North Baltimore, via Van Buren, in the spring.

DAYTON, OHIO.—Representatives of interurban roads radiating from this city have secured an option on a lot in this city on which it is proposed to erect a union passenger and freight station.

TRENTON, N. J.—The American Street Railway Generating & Power Company, with $2,500,000 capitalization, has been incorporated by Edward G. Johnson, Franklin D. Palmer and Joseph F. Vion, of Camden.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Electric Railway Company is securing right of way for a line from Amherst through Birmingham, Florence, Berlin Heights, Avery, Sandusky, Castalia to Fremont.

CLEVELAND, OHIO.—The City Board of Equalization has increased the valuations on the cars owned by the two local railway companies. Originally both companies returned their first-class cars at $900 each and the second-class at $700.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company is considering a proposition to extend its Rock Springs line to Hookstown. It is proposed to open coal mines near that place and haul coal to this city during the night.

ASHTABULA, OHIO.—The Pennsylvania & Ohio Electric Railway Company has commenced work on a line from Conneaut to this place. The power house will be located here. Contracts will be placed in the near future. The road forms a nucleus for a through line from Cleveland to Buffalo.

XENIA, OHIO.—President John P. Martin of the Little Miami Traction Company has announced that the work of financing the Springfield-Xenia branch line has been completed and that work will start as soon as possible. The entire system will include 123 miles of road built entirely on private right of way.

CLEVELAND, OHIO.—The Buckeye Construction & Improvement Company of Cleveland has been incorporated for the purpose of constructing steam and electric railways and for other work. The capital stock is $5,000 and the incorporators A. I. Newman, Philip Heintz, W. C. Voelker, Frank Straus and Albert Straus.

LEGAL.

STORAGE BATTERIES.—Suit was instituted on Dec. 21 by the Electric Storage Battery Company in the United States Circuit Court at Philadelphia against the Helios-Upton Company for damages for alleged infringement of a patent used in the manufacture of electric storage batteries granted in 1894 to the late W. W. Griscom, of Philadelphia.

"GLAZE-FILLED" PORCELAIN INSULATORS.—The long-pending controversy between F. M. Locke and John W. Boch as to priority of invention of "glaze-filled" porcelain insulators has been finally decided by the Court of Appeals of the District of Columbia in favor of Mr. Boch, of the R. Thomas & Sons Company, East Liverpool, Ohio. The court affirmed the decision of the commissioner of patents in favor of Mr. Boch, to whom a patent was granted for the invention March 8, 1898, No. 600,475. The Court of Appeals has also affirmed the action of the commissioner of patents refusing to grant a patent to F. M. Locke for a "fused" insulator.

WESTERN UNION'S RAILWAY RIGHTS.—In the Federal Court at St. Paul on Dec. 22 Judge Leschen decided in favor of the Western Union Telegraph Company in a suit brought by the Great Northern to oust that company. The Great Northern claimed absolute ownership of 860 miles of line. When the road was first constructed a contract was made with the old Northwestern Telegraph Company granting a perpetual right to maintain its line in consideration of the use of wires for the transmission of the railroad company's business. In 1882 the Northwestern leased its line to the Western Union for ninety-nine years. In 1892 the Great Northern began proceedings against the Western Union, claiming ownership, alleging breach of contract on the part of the old Northwestern, and averring that the lease given to the Western Union made the contract void. It is said that the decision is of importance to the Western Union, as other Western railroads similarly situated were prepared to proceed against the telegraph company had the Great Northern won its case.

OBITUARY.

DR. S. HOEPFNER, well known through his invention of the electrolytic treatment of refractory ores, died in Denver, Col., on Dec. 16 at the age of forty-nine years.

PERSONAL.

MR. A. OFFUTT, inspector of the local board of underwriters in New Orleans, La., was married on Dec. 13.

MR. J. H. ASHBY, local manager for the General Electric Company at New Orleans, La., was married on Dec. 13.

MR. W. S. ANDREWS is the author of an extremely interesting little brochure on Roentgen rays, being his paper read before the Schenectady General Electric Engineering Society this year. It is illustrated, and has portraits of Faraday and Roentgen.

MR. J. S. ERDSTROM.—The United States consul at Zurich, Switzerland, describes the recent street railway work done there by Mr. J. Sigfrid Erdstrom, a Swedish engineer, who received his training in this country, and who has used large quantities of American material. He now goes to Gothenburg, Sweden, to carry out some extensive street railway construction there.

MR. R. S. STEARNES, New Orleans, La., well known in the electrical field, and who was formerly connected with the General Electric Company, the Fort Wayne Electric Corporation and latterly with the Westinghouse Electric & Manufacturing Company in that city, will on the first of the new year embark in business on his own account. He will conduct a general contracting business.

MR. E. H. JOHNSON.—The news that Mr. E. H. Johnson was seriously ill in this city has caused a great deal of anxiety to the countless friends of that enthusiastic pioneer in all the later developments of electric light, power and traction. We are heartily glad to announce his convalescence, and even his resumption of work in some new branches that need his skill, experience and indomitable courage.

MR. B. A. BEHREND has accepted the position of designing electrical engineer with the Bullock Electric Manufacturing Company. Mr. Behrend was formerly chief designer of the Oerlikon Works, Switzerland, and for some years has been an authoritative contributor to electrical literature, particularly with respect to the branch of alternating currents. About a year ago he declined an offer from the city of Stuttgart, Germany, of the chair of electrical engineering in the Technical Institute of that city, which is one of the finest in Germany.

Trade Notes.

REMOVAL.—Messrs. Partrick, Carter & Wilkins, Philadelphia, Pa., have moved to the new buildings, 1231 Callowhill Street and 407 North Thirteenth Street.

ELECTRIC CRANES.—William Tod & Company, Youngstown, Ohio, are preparing plans for the erection of a large foundry building, which will be equipped with electric traveling cranes.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, New York, informs us that the address of its Denver, Col., office has been changed from 621 Sixteenth Street to 1732 Champa Street.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, manufacturer of Peerless incandescent lamps, reports an unusually busy season. November shipments were the largest during any one month in the history of the company.

INSULATOR THOUGHTS.—Mr. Fred M. Locke, Victor, N. Y., has sent out a neat little folder giving some tables showing the surface leakage in watts, per insulator, of glass and porcelain insulators. The principal advantages of the Victor insulators are also pointed out.

THE BUCKEYE ENGINE COMPANY, Salem, Ohio, has awarded a contract to the Morgan Engineering Company, Alliance, Ohio, for a large electric traveling crane to be erected in its new foundry. The crane will have a capacity of twenty-five tons and an auxiliary hoist of five tons capacity.

EXPANDING WESTERN TRADE.—Messrs. Greaves, Klusmann & Company, Cincinnati, Ohio, engine lathe builders, note the beginning of activity in the Pacific Slope and Hawaiian Island trade. Two engine lathes have just been shipped by that concern to the islands to be installed in a machine shop there.

THE CHARTER GAS AND GASOLINE ENGINE is fully illustrated and described in a pamphlet issued by the Charter Gas Engine Company, Sterling, Ill. This engine uses gasoline direct from the tank without any complication or manipulation, and is claimed to be one of the best and simplest engines on the market.

THE ECONOMY ELECTRIC COMPANY, Warren, Ohio, claims to be the only factory making a business of renewing burned out incandescent lamps on a large scale. Although its factory output is said to be equal to that of many of the larger manufacturers of new lamps, the demand for its product is fully up to the output.

CHANGE OF ADDRESS.—The Minneapolis office of the Columbia Incandescent Lamp Company, of St. Louis, Mo., is now located at 823-829 Guaranty Building, where a complete stock of lamps will be carried for the benefit of the company's trade in the Northwest. The Columbia Company's trade in that territory has shown a very large increase during the past year.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, has removed its office in San Francisco to 593 Mission Street, where it has much better facilities for accommodating its customers and much better show rooms than it had where it was previously located. Mr. Clark has charge of the office and will take pleasure in showing any apparatus he may have in stock.

MAKING PLAYING CARDS BY ELECTRIC POWER.—The great plant of the United States Playing Card Company, Cincinnati, Ohio, is now one of the finest electrically equipped concerns in the United States. The Bullock Electric Manufacturing Company has furnished a great number of generators and motors, and a number of ingenious devices connecting various departments have been installed.

THE CHRISTENSEN ENGINEERING COMPANY, Milwaukee, Wis., will, in all probability, engage in the manufacture of dynamos and motors. The company has its new shops nearly fitted up and has all the necessary facilities for handling the work. The company has for some time been building its own motors for air-brake work. The dynamos and motors for the electrical drive of the new shops were all built by this company.

THE ALLEGHENY STEEL & IRON COMPANY will erect a steel plant at Brackenridge, Pa. The contract for the buildings has been let to the American Bridge Company. This includes two producer sheds, a boiler house, a main building, an open-hearth building and a crane runway. The main building will be 72 ft. by 252 ft., with four lean-tos. The open-hearth building will be 72 ft. by 161 ft., with three lean-tos. About 500 tons of steel will be required.

GAS AND GASOLINE ENGINES.—The New Era Iron Works, Dayton, Ohio, have just issued a catalogue describing their New Era gas and gasoline en-

gines. The company has recently bought and equipped a new plant for the manufacture of these machines, and its capital has been doubled within the last few months. The company reports that business is so brisk that it is very much behind in its orders. It manufactures engines in sizes from 5 to 125 horse-power.

MR. HUGH H. HUMPHREY, consulting electrical engineer, St. Louis, Mo., has removed his offices from the Century Building to the Chemical Building in that city. Mr. Humphrey has some important work on hand at the present time, the principal contract being for the lighting and power plant for the De Beers Explosives Works at Cape Town, South Africa, consisting of about 1000 horse-power of motors, air compressors, water works pumping plant and a refrigerator plant.

CROSS OIL FILTERS.—The Harrisburg Foundry & Machine Works have recently installed a Cross oil filter, made by the Burt Manufacturing Company, of Akron, Ohio. The Delaware & Hudson Canal Company is now using 21 Cross filters. The Federal Steel Company, of Chicago, has now in use 10 filters. The Burt Manufacturing Company, of Akron, Ohio, has also furnished the United Gas Improvement Company, of Philadelphia, 9 Cross oil filters, all bought at different times.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass., is sending out a special money card to be used by engineers and others desiring to examine its instruction papers and text-books. The card contains a place where a silver 25-cent piece may be inserted and securely sealed. This card contains also a place for name and address and text-book wanted. It may be placed in an envelope and addressed to the school. Any one wishing to examine any of the instruction papers of this school should send for one of these cards in order to send the money safely.

ELECTRICAL MACHINERY.—The Gregory Electric Company, 62 South Clinton Street, Chicago, has issued a fine catalogue giving a list of installations of its apparatus. The company's works are very fully and artistically illustrated, and a page is devoted to portraits of its officers. The list of installations covers practically every State in the Union, and occupies 52 pages of the catalogue. The company points out that it has the largest establishment of the kind in the world, and that it carries larger stocks of dynamos, motors, transformers, etc., than do the original manufacturers themselves.

STEAMBOAT ELECTRIC PLANTS.—The Triumph Electric Company, Cincinnati, Ohio, has closed some important contracts for steamboat plants. The first machines go to the Howard Shipyards, Jeffersonville. Four or five new steamers now on the ways there are to be fitted out electrically. The "Keystone State" in the Cincinnati Packet Line trade has been equipped by the Triumph Company. The same company has put in the power plant for the Geo. Enger Carriage Company, a big Cincinnati concern, consisting of a generator with four or five motors. All the machinery of this company will be driven electrically.

THE EMERSON ELECTRIC MANUFACTURING COMPANY advises that it is designing several new types of alternating-current desk and bracket fans, and one new type of alternating-current ceiling fan which it expects will combine advantages not found in motors of these types at present on the market. These new types will be suitable for operation on low frequency current, and the manufacturer will be pleased to send samples of these new types to any responsible electrical dealer or central station for examination and test, freight charges prepaid. The manufacturer expects these samples to be ready for examination within a few weeks, and suggests that electrical dealers and central stations interested in low frequency ventilating apparatus place their application as soon as possible, as all requests for samples will be filled in the order in which they are received.

THE METROPOLITAN MOTOR EXPRESS COMPANY was incorporated under the laws of the State of New Jersey recently. The officers are: President, Chas. E. Dickinson; vice-presidents, Louis W. Groat and Walter H. Bunn; treasurer, Wm. J. Van Vleck; secretary and general manager, Robert E. Monell. The executive offices will be in New York, and the company expects to do a general express business with electric automobile delivery wagons and vans in that city and the neighboring portions of Long Island and New Jersey. Plans of operation have not yet been formulated, however, so that no definite statement can yet be made as to the intentions of the company.

AUTOMOBILE SHOW IN PHILADELPHIA.—The first annual automobile show of Philadelphia will be held in that city Feb. 4 to 9, inclusive, 1901. The following is a list of entries up to the present time: Locomobile Company of America, Mobile Company of America, Electric Vehicle Company, John Wanamaker, Orient, Foster, Maurice Loeb, De Dion-Bouton, Marlborough, Century, Gray & Davis, Bevin Bell Company, Wharton & Wright, Winton, Reading Steam, Overman, Manufacturers' Supplies Company, Fanning Electric Company, R. C. Wall Manufacturing Company, Chas. F. Swartz, Rose Manufacturing Company, Liberty Bell Company, Diamond Rubber Company, Consolidated Tire Company, Rothchild & Company, Motor Vehicle Power Company, Philadelphia Gas & Gasoline Engine Company, Pennsylvania Rubber Company, Hinchman & Hawkins and Skene American Automobile Company.

TURBINE WATER WHEELS.—The John W. Taylor Manufacturing Company, Mount Holly, N. J., in the latest edition of its catalogue describes the Taylor sleeve gate turbine wheel, which possesses many unique features. An improved style of gate is also described and illustrated. It is propelled by levers and connecting rods on the outside of the flume head. A similar shifting device is used for connection to turbine governors. The catalogue contains diagrams and dimension sheets of the various styles of wheels built by the company. This information will be very valuable to mill superintendents, electrical and mechanical engineers and others interested in lighting plants, since it gives the principal dimensions of the turbine wheels, and places in the hands of those interested ready information on the subject. The Taylor Company has recently made some extensive improvements to its shops and added the latest labor-saving devices for handling heavy work.

LEEDS PORTABLE TESTING SETS.—As sole agent for Morris E. Leeds & Company, Mr. James G. Biddle, Philadelphia, has just issued Pamphlet No. 340, which describes in detail how to make Wheatstone bridge measurements with the apparatus specified. In addition to describing the various styles of testing sets, the pamphlet contains fifteen pages of matter that is of interest to every engineer who requires to test resistances of dynamos, motors, incandescent lamps, wires, cables, magnets, batteries, etc. Some of the methods specifically treated and illustrated by diagrams may be mentioned: "Measurement of a low resistance," "measurement of a high resistance," "insulation resistance," "Murray-loop method of locating grounded or crossed wires," "Varley-loop method of locating grounded or crossed wires," "E.M.F. of batteries," "measure E.M.F. or check a voltmeter," "measure current or check an ammeter," etc. The pamphlet contains an unusual amount of valuable information, and will be mailed free to any one who makes proper request of Mr. Biddle.

THE B. F. STURTEVANT COMPANY, of Boston, reports its business of the past year to have been the largest in its history. In the line of standard types of blowers, exhausters and hot-blast heating apparatus its products have kept pace with the recent industrial movement. But in the installation of fans for the production of mechanical draft for steam boilers the desirability of this method in preference to the chimney has been shown by a great increase. The volume of domestic and foreign orders for forges has been noticeable, while the output of the rapidly growing electrical department has been far in excess of the previous year. This electrical output has been principally in the specialties of this company, namely, electric fans of all types and small, high-grade generating sets. New applications of fans are constantly presenting themselves, and the careful study which this company gives to the solution of such problems is one of the main factors in its growth. All departments have been taxed to the utmost, and the outlook is favorable for the continuation of this condition.

S. Z. DE FERRANTI, Limited, of Hollinwood, Lancashire, England, has just got out a new pamphlet, No. 113, describing some of its standard manufactures, a copy of which it will be glad to send to any one interested. The pamphlet illustrates and describes its work at Hollinwood, showing the manufacture of the Ferranti alternator, engines, rectifiers, transformers, rheostats, high tension switchgear, etc. The pamphlet is well illustrated and is particularly interesting to users of high tension switchboards, the switches for this class of work being shown in detail. As to fatalities in central stations, we cannot refrain from saying that had these stations been equipped with Ferranti boards the accidents would never have happened, as it is almost an impossibility to get a shock off a board equipped with Ferranti apparatus. Too much importance cannot be attached to the safe design of switchboards, and we can recommend central station engineers to communicate with this firm on this particular class of work, to which Mr. Ferranti and his engineers have devoted many years of attention.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED DEC. 18, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

663,859. RECEIVER FOR PRINTING TELEGRAPHS; J. Burry, New York, N. Y. App. filed Aug. 18, 1896. The invention consists of a type wheel having a series of circumferential rows of types, and mounted to rotate in either direction and be shifted in the direction of its length, front or back, and means for moving the same by an electric current and magnets.

663,903. TELEGRAPHIC INSTRUMENT; H. T. Johnson, Jersey City, N. J. App. filed Feb. 26, 1900. The armature lever is pivoted in an adjustable frame which can be moved to regulate the distance between the armature and the magnet.

663,926. AUXILIARY ATTACHMENT FOR SIGNAL BOXES; B. Oehmen, New York, N. Y. App. filed May 22, 1900. An attachment whereby the person sending in a signal will be notified of the reception of the signal after the box has commenced to operate and the signal is being transmitted.

663,929. SYSTEM FOR HEATING CONDUCTORS OF THE SECOND CLASS; C. D. Raab, Kaiserslautern, Germany. App. filed April 30, 1900. (See Current News and Notes.)

663,937. PRIMARY BATTERY; C. H. Schoenmehl, Waterbury, Conn. App. filed Feb. 27, 1900. Details.

663,938. GALVANIC BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed March 22, 1900. Details.

663,995. GERM DESTROYER FOR TELEPHONE MOUTHPIECES; L. L. Lacey, Austin, Texas. App. filed April 20, 1900. The germ destroyer is an electric light mounted in the mouthpiece.

664,004. ELECTRICAL PIANO; S. K. Reynolds, New York, N. Y. App. filed June 10, 1899. This is an electrically operated piano in which solenoids are placed directly over the keyboard so that their cores may rest directly upon the keys; the circuit is closed through the solenoids in the usual manner by means of a cut paper strip and finger contact.

664,006. GALVANIC BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed March 22, 1900. Details.

664,007. GALVANIC BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed June 12, 1900. The object of this invention, as of those of the same patentee above noted, is to produce a type of battery in which the condition of the elements may be easily observed without removing them and to promote uniform consumption of the elements.

664,008. GALVANIC BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed Aug. 21, 1900. (See the preceding patent.)

664,023. ELECTRIC ACCUMULATOR; P. Marino, Brussels, Belgium. App. filed June 23, 1899. A process consisting in adding to an active material comprising lead oxide a liquor composed of distilled water, guncotton, caustic alkali and benzine for the purpose of obtaining adhesion to the electrodes, forming the electrodes so composed first in a solution of bisulphate of lead and ammonia, then in a solution of sucroglycerate of an alkaline earth metal.

664,034. FURNACE; F. H. Becker, Wevelinghoven, Germany. App. filed May 3, 1898. The main feature of the furnace is a hearth in the form of a series of steps over which the material passes and at each step is subjected to the heat of an electric arc.

664,046. SYSTEM OF NON-INTERCHANGEABLE CONTACT PARTS; R. Hundhausen, Wilmersdorf, Germany. App. filed Nov. 4, 1899. The fittings of the contact part are made of certain sizes depending upon the current they are to carry and are so constructed that the wrong sizes cannot be coupled together.

664,061. ELECTRIC SWITCH; C. W. Scott, Lynchburg, Va. App. filed Aug. 16, 1900. Details of a device whereby in the event of trouble on the circuit to one or more of the drops of a switchboard the circuit may be cut out and grounded without interfering with the remaining circuits.

664,077. OPERATING DYNAMO ELECTRIC MACHINES; W. L. R. Emmet, Schenectady, N. Y. App. filed June 29, 1900. (See Current News and Notes.)

664,080. MOTOR SWITCH; H. Geisenhoner, Schenectady, N. Y. App. filed May 4, 1899. A motor switch comprising two circuit-controlling devices, one connecting a rheostat in circuit and the other adapted to short-circuit the same, an operating handle common to both devices, and means for operating the devices in sequence in starting the motor and simultaneously in cutting out the motor.

664,083. CLUTCH FOR ELECTRIC ARC LAMPS; C. E. Harthan, Lynn, Mass. App. filed March 10, 1899. Details of a clamping-shoe clutch.

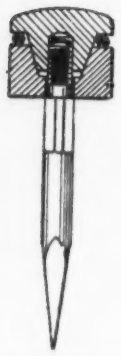
664,086. REGULATOR FOR ELECTRICALLY ACTUATED AIR COMPRESSORS; E. M. Hewlett, Schenectady, N. Y. App. filed Nov. 7, 1898. The first claim defines the invention as follows: In a fluid pressure operated controller for an electric motor, the combination of a switch having two circuit-closing positions, means for causing the switch to assume one or the other position when the pressure reaches its superior and inferior limits, respectively, means for shunting the switch by a circuit of low resistance when in one position, and means for opening the shunt when the switch reaches the second position.

664,087. AUTOMATIC RHEOSTAT; E. M. Hewlett, Schenectady, N. Y. App. filed Nov. 7, 1898. The first claim defines the invention as follows: An automatic rheostat for electric machinery, comprising a resistance with a switch for cutting sections out or in as may be desired, an electromagnet for holding the switch closed when the resistance is out of circuit, and a switch controlled by the magnet for shunting its winding when the current exceeds a determined maximum; whereby the same coil is employed to respond to both maximum and minimum current flow.

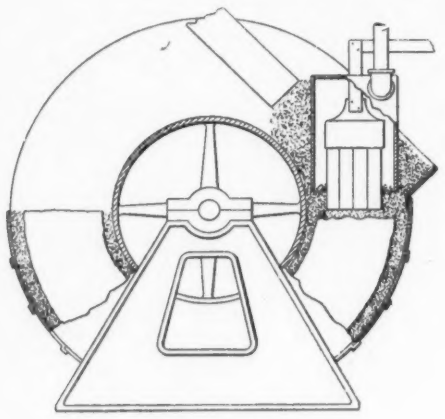
664,092. ELECTRICITY METER; W. M. Mordey and G. C. Fricker, London, England. App. filed Oct. 10, 1900. An improvement upon the class of meter described in U. S. Patent No. 660,021.

664,096. ELECTRIC RAILWAY SYSTEM; William B. Potter, of Schenectady, N. Y. App. filed Oct. 31, 1900. Provides means whereby indications are given to motormen to set their controller handles to positions similar to that occupied by that manipulated by the chief motorman. On each controller shaft is a switch handle carrying contact points which are successively connected with the several cells of a storage battery; as the shaft turns, ammeters at the different car controllers indicate the position of the master controller.

664,105. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Feb. 20, 1900. (See Current News and Notes.)



664,176—Electric Insulator.



664,333—Electric Furnace.

664,106. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 30, 1900. (See Current News and Notes.)

664,144. ELECTRICAL CONNECTION; W. Gerhardt, Hazleton, Pa. App. filed Sept. 27, 1900. Details.

664,163. COMBINED AUTOMATIC GAS LIGHT EXTINGUISHER AND ELECTRIC SPARKER; G. H. Lippmann, Milwaukee, Wis. App. filed March 20, 1900. In connection with the sparking devices is an automatic device for completely closing the valve, even though a partial closure only has been made by hand.

664,176. ELECTRIC INSULATOR; E. Risler, Freiburg, Germany. App. filed July 25, 1900. The insulator consists of a steel pin on the end of which is a button of an insulating material, in two parts, one of which screws onto the pin so that the wire can be clamped between the two parts.

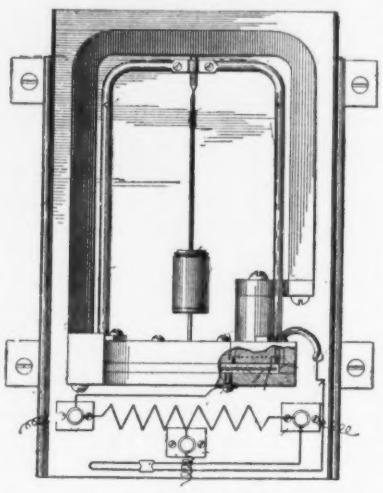
664,189. ELECTRICAL SWITCH CAP; G. B. Thomas, Hartford, Conn. App. filed Aug. 27, 1900. The metallic cap covering a switch is provided with an insulating lining and with a central eyelet of the same material.

664,190. ALTERNATING-CURRENT ELECTRIC MOTOR; E. Thomson, Swampscott, Mass. App. filed Aug. 19, 1897. (See Current News and Notes.)

664,191. CALL REGISTER OR SERVICE METER CIRCUIT FOR SWITCHBOARD APPARATUS; G. K. Thompson, Malden, Mass. App. filed Oct. 8, 1900. A device for switching in additional battery to make sure of the operation of the register.

664,195. CONTROLLER SWITCH; N. Vance, Chicago, Ill. App. filed July 23, 1900. Details.

664,198. SECONDARY BATTERY; F. W. Wetherill, Philadelphia, Pa. App. filed Feb. 4, 1899. To separate and insulate the plates, their edges are set into asphalt.



664,265—Electric Meter.

664,207. RAILWAY SIGNALING DEVICE; R. B. Benjamin, Chicago, Ill. App. filed Feb. 5, 1900. A magnetic generator is operated by the wheels of a train through suitable levers and the current thus generated operates a signal.

664,209. ELECTRIC ARC LAMP; J. A. Brennan, Worcester, Mass. App. filed Sept. 11, 1897. Between the cover plate of the lamp and the hanger board springs are inserted which tend to hold the two parts in parallelism and thus maintain the lamp in a vertical position.

664,219. COMMUTATOR; F. Kaeferle, Hanover, Germany. App. filed Sept. 15, 1900. Details of the manner of holding the segments in position.

664,247. DYNAMO ELECTRIC MACHINE; J. B. Entz, Philadelphia, Pa. App. filed Nov. 27, 1897. An electric generator or motor having the magnetic material of the magnetic circuit which is constituted by the field and armature, magnetically subdivided as to one at least of its said parts by an interposed medium, such as an air-gap of relatively high magnetic resistance, the subdivisions so constituted extending in the direction of the desired magnetic circuit, and adapted thereby to direct and equalize the intensity of the field of force.

664,265. ELECTRIC METER; E. S. Halsey, Chicago, Ill. App. filed July 5, 1900. The motor consists of a constant magnetic field in which rotates an armature consisting of a copper disk carried by a vertical shaft, geared to the recording mechanism. The armature is submerged in mercury at the opposite borders of the field, so that the current must travel the whole length of the field.

664,269. PROCESS OF RECOVERING ZINC; C. Hoepfner, Frankfort-on-the-Main, Germany. App. filed Nov. 18, 1897. The process consists in acting upon zinc oxid or a material containing it, with a solution of calcium chlorid at a temperature above normal and a pressure above atmospheric, and precipitating the zinc as a hydroxid.

664,301. INSULATOR; R. H. Sterling, Pittsfield, Mass. App. filed March 14, 1900. The top of the insulator is formed with a gutter and a spout for conducting away water.

664,308. ELECTROTHERAPEUTIC SPECTACLES; T. B. Zeller, Pittsburg, Pa. App. filed Oct. 29, 1900. The nose bridge and temple fixture of the spectacles are the positive and negative elements of a couple.

664,331. PROTECTIVE APPLIANCE FOR MILLS, FACTORIES, ETC.; M. Martin, Malden, Mass. App. filed Oct. 17, 1898. An electrical device applied to sprinklers for the purpose of sending an alarm in case the sprinklers leak.

664,333. ELECTRIC FURNACE; J. M. Morehead, Chicago, Ill. App. filed Dec. 12, 1899. Comprises a closed hood and a furnace bottom movable in respect to each other and devices for receiving a packing of material between these two parts to exclude air and direct the gases into the hood.

664,334. MANUFACTURE OF CARBID OF CALCIUM; J. M. Morehead, Chicago, Ill. App. filed Dec. 12, 1899. The method practiced in the apparatus described in the preceding patent.

664,346. TELEPHONE CALL REGISTER; W. H. Barker, Hartford, Conn. App. filed Aug. 10, 1898. A key operated register placed upon the subscriber's instrument.

664,348. ELECTRIC CLOCK; U. L. Collins, St. Louis, Mo. App. filed Nov. 20, 1899. Details.

664,362. GALVANIC BATTERY; E. L. Slocum, Pawtucket, R. I. App. filed March 7, 1896. The bottom of the jar is formed with pockets adapted to contain quicksilver in which the ends of the zincs stand.

664,366. FIRE ALARM TELEGRAPH BOX; L. G. Woolley, Kenton, Ohio. App. filed Dec. 28, 1899. A magneto electric generator is used to send in the alarm instead of a battery as customary.

664,367. ELECTRIC CIRCUIT INDICATOR; L. G. Woolley, Kenton, Ohio. App. filed Dec. 28, 1899. A device for use in connection with a magnetic box to sound an alarm whenever the circuit is impaired.

GENERAL LIBRARY
UNIV. OF MICH.
FEB 11 1901

ELECTRICAL WORLD AND ENGINEER

ELECTRICAL WORLD AND ENGINEER
Vol. 36. No. 26

NEW YORK, DECEMBER 29, 1900.

$3 a Year in the U. S., Canada or Mexico.
Single Copies, 10 Cents.

GOLD MEDAL
AWARDED

SCHIEREN'S
LEATHER BELTING
...At Paris, 1900...
NEW YORK. PITTSBURG. PHILA.
BOSTON CHICAGO.

1889
PARIS EXPOSITION
Medal for
Rubber Insulation

OKONITE
TRADE MARK

1893
WORLD'S FAIR
Medal for
Rubber Insulation

THE STANDARD FOR RUBBER INSULATION
Sole Mfrs. of Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-Proof Wires.
THE OKONITE CO., Ltd.
Willard L. Candee, H. Durant Cheever } Managers
253 Broadway, New York
Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Sec'y.

Packards
Lamps and...
Transformers
NEW YORK & OHIO COMPANY,
WARREN, OHIO.
NEW YORK OFFICE: 1 Broadway.

I-T-E CIRCUIT BREAKERS
CUTTER ELECTRICAL AND MFG. CO., PHILADELPHIA

THE RIKER MOTOR VEHICLE CO.,
AUTOMOBILES, ELIZABETHPORT, N. J.

ALFRED F. MOORE,
Manufacturer of
Insulated Electric Wire,
FLEXIBLE CORDS AND CABLES.
200 and 202 North Third Street, PHILADELPHIA, PA.

ALL OUR WIRES---NEW CODE STANDARD.
NEW YORK INSULATED WIRE COMPANY,
Main Office: 13-17 Cortlandt St., N. Y.
Branches: CHICAGO, 320 Dearborn St.; BOSTON, 134 Congress St.; SAN FRANCISCO, 71 Flood Building.

INDIANA RUBBER AND INSULATED WIRE CO.
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory, JONESBORO, IND.

EMPIRE ELECTRICAL INSTRUMENTS
EMPIRE ELECTRICAL INSTRUMENT CO.,
654 HUDSON ST., NEW YORK

SPECIAL DYNAMO BELT
None Genuine without SABLE stamped every ten feet.
NEW YORK N. Y., 113 LIBERTY St., A. B. Laurence, Manager.
BOSTON, MASS., 184 Summer St., J. A. Ferguson, Manager.
PHILADELPHIA, PA., 110 N. 3d St., A. M. McComb, Manager.

The Phoenix Glass Co.
GAS AND ELECTRIC
GLOBES, SHADES, ETC.
Send for Catalogue No. 3.
Pittsburg. New York. Chicago.

Silver Medal Paris Exposition
Every electric light and railway plant should be provided with
Bristol's Recording
Volt and Ammeters
Makes continuous record day and night. Send for circular.
THE BRISTOL CO.
Waterbury, Conn.
N. Y. Branch, 121 Liberty St.

"Phono-Electric" Wire "It's tough"
High Tensile Strength
High Elastic Limit
Bridgeport Brass Co., 19 Murray St., New York.

National India Rubber Co.,
RUBBER COVERED
N. I. R.
WIRES AND CABLES.
Office and Factory, BRISTOL, R. I.

NATIONAL CONDUIT AND CABLE COMPANY,
Manufacturers and Patentees of
Paper Insulated Cables and Wrought-Iron Cement Lined Pipes for Underground Subways.
Main Office, Times Bldg, N.Y.
73,000,000 feet of our Conduit and thousands of miles of our Cables in use in the United States, Canada and the British Isles.
BRANCH: Ames Building, Boston, Mass.

JENKINS' '96 PACKING
Pronounced by steam users throughout the world the best joint packing manufactured. Expensive? Not at all, as it weighs 30 per cent less than many other packings, consequently is much cheaper.
JENKINS BROTHERS
New York Boston Philadelphia (x) Chicago

NAME PLATES
FOR MOTORS DYNAMOS AND ALL MACHINERY & ELECTRICAL APPARATUS
SIZES 1½X3½ TO 6X22 PER 100-2X4 TO 5X18 PER 100-OTHERS IN PROPORTION.
A. BECKER ENG. CO. 34 OLIVER ST. BOSTON, MASS.

AUTOMATIC ELECTRIC
CIRCUIT BREAKERS
ABSOLUTE IN THEIR ACTION
THE W. R. GARTON COMPANY
ELECTRICAL SUPPLIES, CHICAGO.

THE UNITED STATES CARBON COMPANY,
CARBONS
ENCLOSED ARC CARBONS
ALTERNATING AND DIRECT
SOLID AND CORED
PLAIN AND COPPER COATED
CLEVELAND, OHIO, U.S.A. NOT IN THE CARBON TRUST.

SIMPLEX INSULATED WIRES AND CABLES....
Rubber Covered, Weatherproof, Underground and Submarine.
WESTERN SELLING AGENT
H. R. HIXSON,
137 Monadnock Block, CHICAGO.
Simplex Electrical Company,
75-81 Cornhill, BOSTON, MASS.

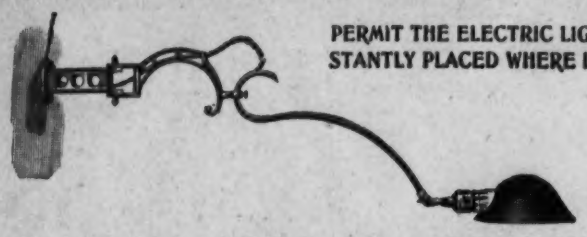
ALPHABETICAL INDEX TO ADVERTISERS, PAGES 24 AND 26.

CLASSIFIED LIST OF ADVERTISERS, PAGES 27, 28, 30 AND 32.

PLATINUM

IN SHEET OR WIRE
FOR ALL PURPOSES.
SCRAP PURCHASED.
C. F. CROSELMIRE,
251 to 255 New Jersey R. R. Ave.,
NEWARK, N. J.

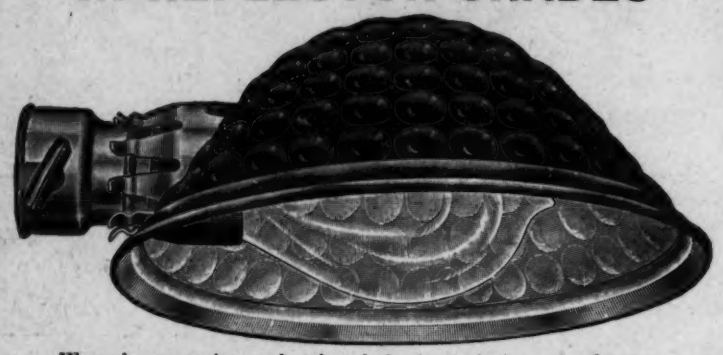
FARIES ADJUSTABLE LAMP HOLDERS



PERMIT THE ELECTRIC LIGHT TO BE INSTANTLY PLACED WHERE IT IS NEEDED

Made for shop, factory, store, office, residence—in fact wherever the incandescent lamp is used.

THE LATEST AND BEST THING IN REFLECTOR SHADES



We make many sizes and styles of aluminum shades and reflectors.

CATALOGUE NO. 8 of adjustable holders, portables, chandeliers, wall brackets, etc., just issued, will be mailed upon application.

FARIES MFG. CO., Decatur, Ill.

The O. C. WHITE CO., - - Worcester, Mass.

STANDARD ADJUSTABLE FIXTURES.

Shop Fixtures, Office Fixtures, Desk Fixtures, House Fixtures.

We "Double the efficiency and convenience of incandescent light." Send for our Catalogue B.

VULCANIZED FIBRE

Highest grade for electrical insulation and mechanical purposes. In sheets, tubes, rods and special shapes.

CATALOGUE AND SAMPLES ON APPLICATION.

VULCANIZED FIBRE CO., ... Wilmington, Del.

DIAMOND STATE FIBRE CO.

HARD FIBRE FOR ELECTRICAL INSULATION

ALSO FIBRE CARS AND BASKETS

CATALOGUE ON APPLICATION ELSMERE, DELAWARE

100 McCREARY SPECIALTIES.

Lamps, Reflectors, Half Shades, Etc.

SEND FOR DESCRIPTIVE MATTER.

The A. A. McCREARY CO., 136 Liberty Street, New York.

"PERFECTION"

LAMP GUARDS

Awarded Bronze Medal, Highest Prize, Paris Exposition of 1900

WM. INGLIS WIRE & IRON WORKS, DETROIT, MICH.

GUARD CLOSED Catalogue and Prices upon Application GUARD OPEN

SHEET LEAD

COLWELL LEAD CO., 63 Centre St., N. Y.

ALSO MANUFACTURERS OF
Lead Pipe, Lead Tubing, Ribbon Lead, Etc.,
For Electrical Purposes.

American Vitrified Conduit Company

MANUFACTURERS OF
VITRIFIED SALT GLAZED
UNDERGROUND AND INTERIOR CONDUITS.
Contractors for Complete Installation of Conduit Systems.
General Offices: 39 Cortlandt St., N. Y.

INDIA AND AMBER MICA

Uncut
Or cut to any
Size or Pattern
Washers.

SAMPLES AND QUOTATIONS FURNISHED

A. O. SCHOONMAKER, 158 William Street, New York.

STANLEY A. C. WATTMETERS

Permanent Accuracy Guaranteed

STANLEY INSTRUMENT CO.
New York: 146 Broadway.
San Francisco: 31-33 New Montgomery St.
Canada: The Royal Electric Co., Montreal and Toronto

W. R. OSTRANDER & CO.

MANUFACTURERS OF

Electric Bells, Speaking Tubes, Pneumatic Bells,
Burglar Alarms, Elbows, Pneumatic Dispatch Tubes
Annunciators, Whistles, Mechanical Bells,
Gas-Lighting Burners, Mouthpieces, Spark Coils.

EVERYTHING FOR HOUSE, HOTEL OR FACTORY USE.

Factory, 1423-1425 De Kalb Ave., Brooklyn. 22 DEY STREET, NEW YORK.

MICHIGAN ELECTRIC CO., Detroit, Mich.

ELECTRIC

Supplies
Machinery
Signs
Fixtures

REWINDING AND REPAIRS

The Natural Law

MONTAUK FIRE-DETECTING WIRE

Every infinitesimal point is a Thermostat delicately sensitive to fire or dangerous heat..

That Heat will Expand Metal

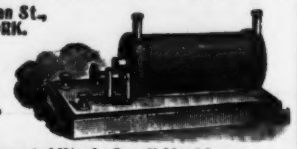
affords a positiveness to the action of Montauk Fire-Detecting wire that is invaluable.
Montauk Wire is a service wire; it is designed for all the uses that ordinary electrical conductors are put to. Connecting bells, etc., with Montauk Wire gives the same bell service that ordinary wire does, and has the added advantage that in case of fire the wire will ring the bell.
Full data for the asking. Booklet No. 71 will interest you.

MONTAUK MULTIPHASE CABLE CO., 100 Broadway, New York [1]

BAKER & CO.,
NEWARK, N. J.
New York Office, 120 Liberty Street.
in Sheet or Wire, any degree of hardness.

PLATINUM
FOR ALL PURPOSES.

FOR ELECTRIC
GAS LIGHTING SPECIALTIES
OF ALL DESCRIPTIONS
Apply to
A. L. BOGART COMPANY
[illegible] Liberty St., New York City.

INTERNATIONAL ELECTRIC CO.
76 Beekman St., NEW YORK.
Brass Turning, Gear Cutting, Press Work, Fine Wire Winding.

Experimental Work, Small Machinery.

FOR MICA
Sheet, cut or uncut, Powdered and Flake
WRITE TO
ASHEVILLE MICA CO.
ASHEVILLE. N. C.

The Standard Open Circuit Batteries of the World.
Send for Circular and Prices.
THE LECLANCHÉ BATTERY CO.
111 to 117 East 131st St., N. Y.

When writing to advertisers please mention ELECTRICAL WORLD AND ENGINEER.

SHELBY LAMPS SHELBY, OHIO.

WRIGHT & CRAYCROFT
MANUFACTURERS OF
Hard and Soft Wood Mouldings
PLAIN AND POLISHED
ELECTRICAL MOULDINGS A SPECIALTY
518 to 542 WEST TWENTY-FIRST ST.,
Telephone, Canal. 396 CHICAGO, ILL.

MONEY WELL SPENT.
Any device that cuts down your expense one-half is not only a needed reform but a necessity.

THE CROSS OIL FILTER
will save you 50 per cent on your oil bills. We have convinced thousands—why not you?
Let us send you one on approval at our expense?
THE BURT MFG. CO., Akron, Ohio, U. S. A.
Largest Manufacturers of Oil Filters in the World.
We also make the BURT EXHAUST HEAD.

KELLOGG SWITCHBOARD AND SUPPLY CO.
231 So. Green St., Chicago
WE ARE PREPARED TO FURNISH BEST QUALITY
Fine Magnet
Annunciator
Jumper
WIRE
Also
Switchboard
Cable
ANY SILK OR COTTON INSULATED WIRE MADE TO ORDER
STANDARD PRODUCTS IN STOCK

IT BRINGS BUSINESS

A permanent exhibit at the Bourse will bring your goods directly to the notice of buyers. The Exhibition Department of the Bourse presents an opportunity to maintain a permanent exhibit in the business centre of the city.

18,000 square feet devoted to the display of Mechanical and Electrical Appliances. Spaces from twenty feet square and upward can be rented with steam, electric, gas or water power.

FOR PLANS AND FULL PARTICULARS ADDRESS
Exhibition Department
THE BOURSE,
PHILADELPHIA. (2)

The Word Peak virtually means the hardest part of your power stations day's work. Provision must be made for the peak, although but a fraction of the amount of energy represented by it is normal.
By taking a large portion of the peak and smoothing out the load fluctuations, a storage battery will increase the capacity of an Electric Railway Power Station and decrease the cost of operation. The Chloride Accumulator represents the latest development of Storage Battery Construction.

Engineering advice and illustrated descriptive bulletins at your service for the asking.
THE ELECTRIC STORAGE BATTERY CO., 19th St. & Allegheny Ave., Phila., Pa.
SALES OFFICES: NEW YORK, 100 Broadway; BOSTON, 60 State St.; BALTIMORE, Equitable Bldg.; CHICAGO, Marquette Bldg.; DETROIT, Mich. Electric Co.
L-29-8

QUEEN INSTRUMENTS

Q-W METERS are suitable for both direct and alternating current circuits. Supplied in either switchboard or portable form.

QUEEN METERS are excellent for laboratory work. They indicate polarity, and the scale divisions are nearly proportional. They can be supplied in switchboard type if desired.

DYNAMOMETERS, PHOTOMETERS, PORTABLE TESTING SETS, CABLE TESTING APPARATUS, INDUCTION COILS, SCIENTIFIC APPARATUS.

QUEEN & CO., Inc.

J. G. GRAY, President.

59 Fifth Avenue, New York. 1010 CHESTNUT STREET, PHILADELPHIA. 480 Monon Building, Chicago

VOLT-AMMETERS

POCKET SIZES VARIOUS RANGES.

for Testing Storage and Primary Batteries and for ascertaining the condition of Battery Circuits, locating faults, grounds, etc : : : : : : : : : : :

ACCURATE. RELIABLE.

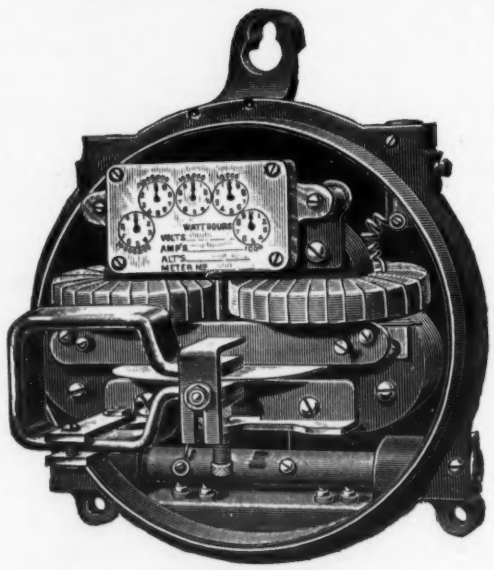
LOUIS M. PIGNOLET, 78 Cortlandt St., New York.

BOOKS

ON ANY ELECTRICAL SUBJECT sent, prepaid, to any address in the world, upon receipt of price. Send for Catalogue.

ELECTRICAL WORLD and ENGINEER, 120 Liberty Street, New York.

Scheeffer Recording Watt-Meter



Round Pattern
Type "E"
For Alternating Currents
An Accurate and Sensitive Meter
Improved Ball Bearing

DIAMOND METER COMPANY

PEORIA, ILL., U. S. A.

WILLYOUNG INSTRUMENTS.

Portable Test Sets,
Conductivity Bridges,
Cable Testing Apparatus.
X Ray Machines,
X Ray Tubes,
Fluoroscopes.

Condensers for Telephone Systems.

Experimental apparatus to order from our own or customer's designs.

We want you on our mailing lis .

ELMER G. WILLYOUNG, 92-94 Fulton St., N.Y.

NORTON Ammeters and Voltmeters

High-Grade Instruments at Moderate Cost. Write for Circular and Price List.

THE NORTON ELECTRICAL INSTRUMENT CO.

(2) Main Office and Factory, Manchester, Conn.

Agents: Kohler Bros., Chicago, Ill.; Newman-Spranley Co , New Orleans, La.

An A 1 Instrument

FOR MEASURING RESISTANCES

A DIRECT READING OHMMETER

OHMMETERS
AMMETERS VOLTMETERS

F. B. SAGE & BRO.

Successors to
Amer. Elec. Specialty Co.
123 Liberty Street, N. Y.
N. Y. Agent Wirt Electric Co.

RHEOSTATS AND BRUSHES

DESHLER-MAC ALLISTER PORTABLE PHOTOMETERS

KNOW what you buy.
Make your own lamp tests.
Make them just when you want them.

Write us for details.

ELECTRIC MOTOR AND EQUIPMENT CO.

12 & 14 BEAVER STREET, NEWARK, N. J.

CARY SPRING WORKS

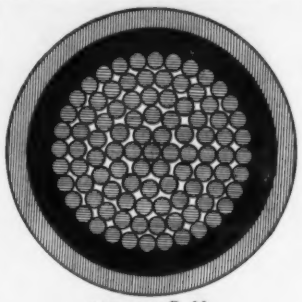
240 and 242 West 29th St., New York City

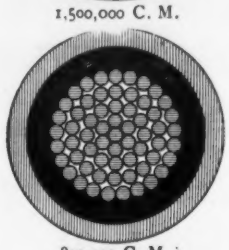
Manufacturers of

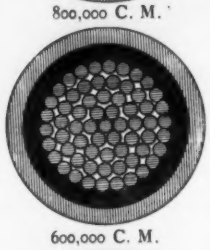
WIRE and SPRINGS OF ALL KINDS

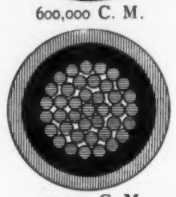
Telephone 3346 38th St.

You can increase the efficiency of your advertising by sending us NEW CUTS frequently.


1,500,000 C. M.


800,000 C. M.

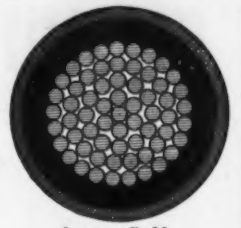

600,000 C. M.

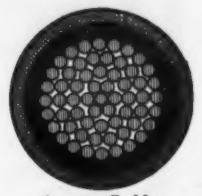

400,000 C. M

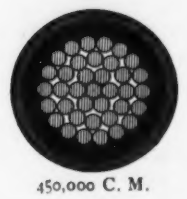
Lead Covered Braided Rubber Covered Cables.

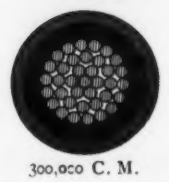
Weather Proof Wire,

All Commercial Sizes.


800,000 C. M.


600,000 C. M.


450,000 C. M.


300,000 C. M.

WESTERN ELECTRIC COMPANY,

CHICAGO. **NEW YORK.**

AMERICAN ELECTRIC COMPANY.
Northwestern Agents, St. Paul, Minn.

ST. LOUIS OFFICE,
10 Security Building, St. Louis Mo.

LONDON:
Bridge Chambers, 171 Queen Victoria St., E. C. and North Woolwich, E.

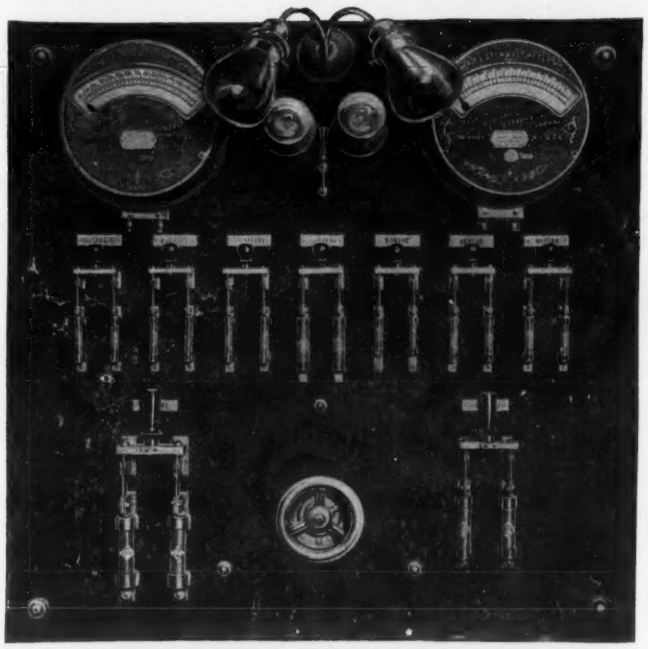
ANTWERP:
32 Rue Boudewyns.

PARIS:
46 Avenue de Breteuil.

OPEN FUSES HAVE RUINED MANY SWITCHBOARDS NOARK FUSES DO NOT DESTROY BUT SAVE

Our type B, C or D Clips can be mounted on the face or back of any Switch or Panel Board, and Fuses can be inserted or removed without a screwdriver. Can you afford to lose time with screw contacts?

SACHS NOARK FUSES
Mounted on a 220 Volt Switchboard



Noark Fuses

Are made to suit Conditions.
They will blow without Arc or Flash if the right Fuse is used in the right place.

CATALOGUE TELLS ABOUT THEM. YOURS IF WANTED.

Boston
Chicago

H. W. JOHNS M'F'G CO.

100 WILLIAM ST., NEW YORK
Western Representatives: Manville Cov'g Co., Chicago

Philadelphia
Pittsburgh

PAMPHLET No. 340

WHICH DESCRIBES
THE NEW : : : :

Portable Testing Sets

MADE BY LEEDS & CO.

also contains 15 pages devoted to explaining with much detail (illustrated by diagrams) just how to make "Wheatstone bridge" measurements. This data is of great value in testing dynamos, motors, lamps, wire, cables, magnets—in fact, resistances of any kind.

The pamphlet is free upon request to any one who will make proper use of it. Write (a letter) for a copy or send business card.

JAMES G. BIDDLE,

Sole Agent for LEEDS & CO.,

1023 Stephen Girard Building, PHILADELPHIA

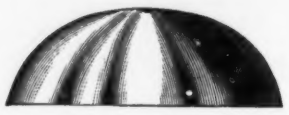
GONGS AND BELLS

We Manufacture

The "Bevin" Automobile Bell

Unmounted bells of all styles and sizes, for electrical and other purposes.

Automobile Bells
Telephone Bells
Monitor Bells
Alarm Bells
Gong Bells
Signal Gongs
Patrol Gongs



Unmounted Bells in Struck Up and Cast Metal

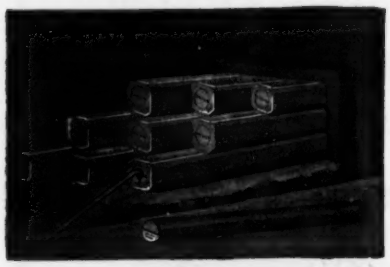
Send for Our Catalog Descriptive of all Styles and Sizes

BEVIN BROS. MFG. CO.

EAST HAMPTON, CONN., U. S. A.

THE H. B. CAMP COMPANY'S
VITRIFIED CLAY CONDUIT

For Underground Telephone, Telegraph or Electric Light Wires.



This conduit is made of vitrified clay standard size, three inches internal diameter. We can make any size or multiple of ducts desired. Laid with our patent Mandrel, a perfect alignment is insured. We claim for strength, economy, durability simplicity, cheapness and perfect insulation it is the best. It is not affected by electrolysis and is acid, gas and waterproof. Any information cheerfully given.

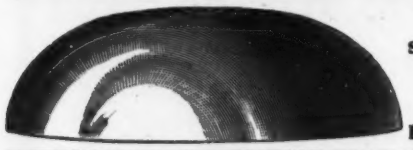
THE H. B. CAMP COMPANY,

307 Park St., AKRON, OHIO.

GONGS AND BELLS

ADAPTED TO

ELECTRIC AND OTHER PURPOSES



Send for catalogue containing over 100 styles and sizes.

N. N. HILL BRASS CO.,

EAST HAMPTON, - - CONN

Paillard Non-magnetic Watches.....

Endorsed by the greatest electricians and scientists of the world. A descriptive catalogue on application

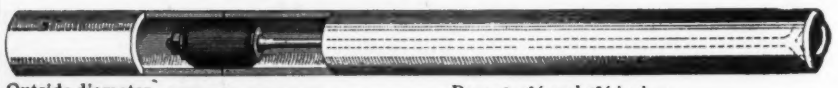
A. C. BECKEN

103 State Street. CHICAGO, ILL.

....Correspondence solicited....

STONE CONDUIT

15 TO 20 PER CENT. LESS THAN TILE CONSTRUCTION



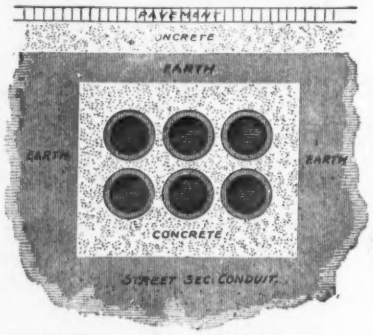
Outside diameter, 4½ inches. *PATENTS PENDING.* Bore, 3, 3⅛ and 3¼ inches. Length, 6 feet.

Pipe are easily sawed to any desired length or angle.

NO INSPECTION OF PIPE REQUIRED — All Pipe are Perfect — WE STAND LOSS BY BREAKAGE

PORTLAND CEMENT and *CRUSHED STONE* are the only materials entering into the construction of our

UNDERGROUND SUBWAY SYSTEM



INDESTRUCTIBLE

A SOLID BLOCK OF STONE WITHOUT JOINTS, AND A GOOD NON-CONDUCTOR

EVERLASTING

CONSTRUCTION IS VERY RAPID, USING ONLY ORDINARY LABOR IN THE ENTIRE WORK

WATER AND GAS-PROOF

It is the strongest of CONDUIT STRUCTURES, as the concrete unites with the exterior of the pipe.

Pipe are manufactured by a new process of subjecting the material to an IMMENSE PRESSURE from the INTERIOR of the pipe which gives a bore of PERFECT DIAMETER and POLISHED SMOOTHNESS, the whole having a uniform strength and density. Such pipe when laid in concrete with our RUBBER MANDREL, under EXPANSION, have perfect ALIGNMENT without chance of error in construction.

We build complete underground subway systems.

AMERICAN STONE CONDUIT CO.

WEST EIGHTEENTH AND SOUTH LINCOLN STREETS

CHICAGO, ILLINOIS, U. S. A.

WRITE FOR SAMPLE OR OTHER INFORMATION

Fort Wayne Electric Works

(INCORPORATED)

The
Latest Developement
in
TRANSFORMERS,
Our
"WOOD" TYPE A
OIL TRANSFORMERS.
Capacities
from 5 to 1200 Lights.

Our Bulletin No. 1013
will give you details.
Write for one.

MAIN OFFICE
AND FACTORY:

TYPE A. 5 K. W. UNIT.

SOME FACTS.

Highest Efficiency.
Best Regulation.
Low Core Loss.
Interchangeable
Primaries
and Secondaries.
Careful Mechanical
Design.

FORT WAYNE,
INDIANA.

GUTMANN WATTMETERS

ARE THE MOST RELIABLE.

SANGAMO ELECTRIC COMPANY,

SPRINGFIELD, ILLINOIS, U. S. A.

Electrical Wires and Cables

JOHN A. ROEBLING'S SONS CO.

TRENTON, N. J.

RAIL BONDS. SUSPENSION STRAND.

ELECTRIC HEATING APPARATUS

All Kinds for All Purposes

Hadaway Electric Heating and Engineering Co.

107 Liberty Street. NEW YORK

IN "AIR PROPELLORS"

We
Have Set
A New
Standard

ASK FOR
PRICES.

THE
Fuller
Co.
Detroit, Mich.
U. S. A.

Manufacturers of
Electrical
and
Ventilating
Apparatus.

SOLD BY

London, Eng.—Wm. Key, 11 Queen Victoria St., E. C.
Paris, France.—E. H. Cadiot, 12 Rue St. Georges.
Glasgow, Scotland.—Wm. Key, Central Chambers, 109 Hope St.
Yokohama, Japan.—Bagnall & Hilles.
New York.—Western Electric Company.
Washington.—National Electric Supply Co.
Wilmington.—Garrett, Millet & Co.
Denver.—Thos. H. Smith.
Hendrie & Bolthoff.
Los Angeles.—Western Electric Works.
Minneapolis.—Roberts Heating & Vent. Co.
Milwaukee.—George F. Rohn.
Chicago.—Western Electric Co.
Central Electric Co.
St. Louis.—Western Electric Supply Co.
Boston.—Smith & Anthony.
South Bend, Ind.—Miller-Knoblock Co.
Peck-Hammond Co., Cincinnati, O., General Southern Agents.

There Is No Higher-class India-rubber Insulation for Wires and Cables than

Habirshaw

AUTHORIZED MANUFACTURERS OF THE..... ATTIX FLEXIBLE TUBE WIRE

The India Rubber and Gutta Percha Insulating Co.

Main Office, Glenwood Works,

J. W. GODFREY, Manager Sales,
15 Cortlandt Street, New York.

YONKERS, N. Y.

TRANSFORMERS.

Catalogue B, Bulletins, Nos. 1, 2, 3, 4, 5 and 6.
THE PITTSBURGH TRANSFORMER CO.,
Pittsburgh, Pa.

Royal Electric Co.,

MANUFACTURERS OF

ALTERNATORS :-: TRANSFORMERS

PEORIA., ILL.

BALL ELECTRIC CO.

ARC DYNAMOS
ENCLOSED LAMPS

404 W. 27th St.
NEW YORK

JENNEY DYNAMOS AND MOTORS

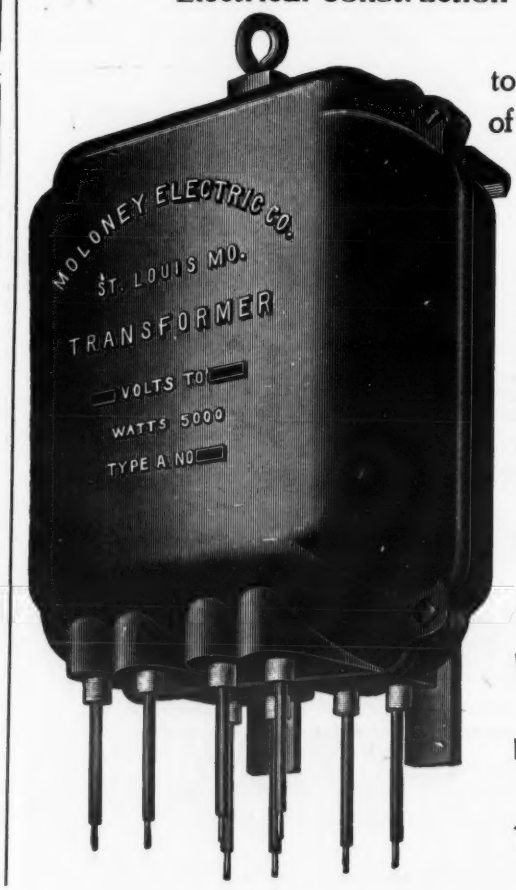
ARE STRICTLY HIGH GRADE.

JENNEY ELECTRIC MFG. CO., ... Indianapolis, Ind.

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

MOLONEY TRANSFORMERS

Are Splendid in Mechanical and Electrical Construction . . . . .



They are designed to meet the demands of Central Station managers.

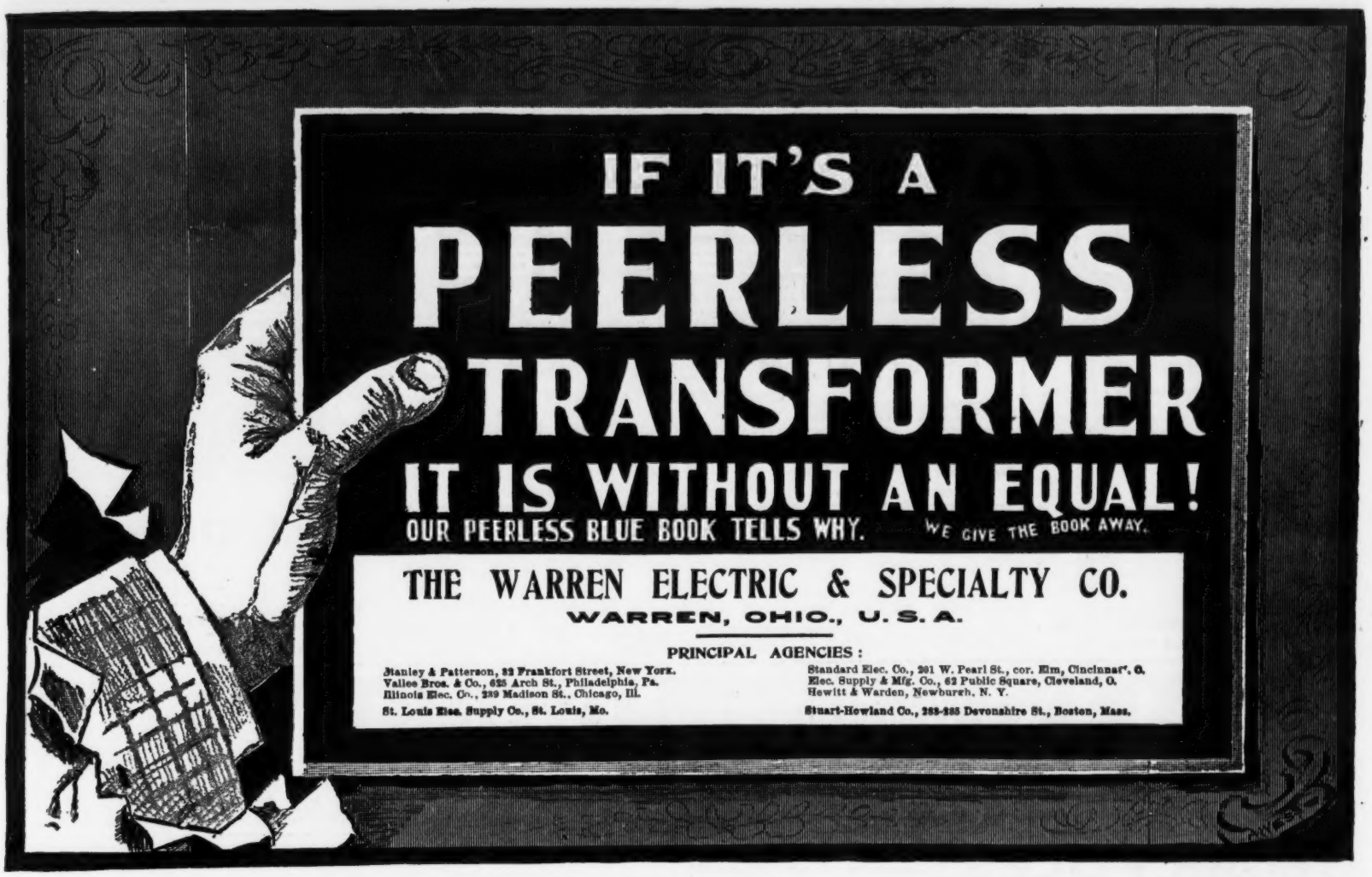
Built for any Voltage, Frequency, or Capacity. Guaranteed for 2 years. Prompt shipment made from stock.

Export Trade Given Special Attention.

Western Electrical Supply Co., St. Louis.

Northwest Elec. Engineering Co., Portland, Oregon.

The W. R. Garton Co., Chicago, Ill.


IF IT'S A
PEERLESS
TRANSFORMER
IT IS WITHOUT AN EQUAL!
OUR PEERLESS BLUE BOOK TELLS WHY.
WE GIVE THE BOOK AWAY.
THE WARREN ELECTRIC & SPECIALTY CO.
WARREN, OHIO., U. S. A.
PRINCIPAL AGENCIES :
Stanley & Patterson, 32 Frankfort Street, New York.
Vallee Bros. & Co., 625 Arch St., Philadelphia, Pa.
Illinois Elec. Co., 239 Madison St., Chicago, Ill.
St. Louis Elec. Supply Co., St. Louis, Mo.
Standard Elec. Co., 201 W. Pearl St., cor. Elm, Cincinnati, O.
Elec. Supply & Mfg. Co., 62 Public Square, Cleveland, O.
Hewitt & Warden, Newburgh, N. Y.
Stuart-Howland Co., 283-285 Devonshire St., Boston, Mass.

THE GENERAL ELECTRIC COMPANY'S

Switchboard Instruments.

Thomson Astatic Ammeters and Voltmeters.

STANDARD FOR DIRECT CURRENT MEASUREMENTS.

General Office: Schenectady, N. Y.

New York Office, 44 Broad Street.

Sales Offices in All Large Cities.

STEWART LAMP CORD ADJUSTER

(Patented Aug. 21, 1900.)

Illustrations show two methods of adjustment. Can be put on or taken off at any time without disconnecting socket or rosette. Permits use of any size cord. Made of fibre. Samples free. Low price.

SOLD BY

CENTRAL ELEC. CO.....Chicago
ELECTRIC GAS LTG. CO.....Boston
W. R. OSTRANDER & CO.....New York
F. BISSELL CO.....Toledo, O.
CHAS. B. SCOTT.....Scranton, Pa.
L. P. CLARK & CO.....Phila., Pa.
RUMSEY ELEC. M. CO.....Phila., Pa.
ROBT. L. MCOUAT.....Indianapolis, Ind.
E. G. BERNARD.....Troy, N. Y.

MANUFACTURED BY

FRANK H. STEWART & CO.,
35 N. 7th Street, Phila.

CREAGHEAD ENGINEERING CO.

Creaghead Mast Arms
MANY STYLES, FOR WOOD OR IRON POLES

CINCINNATI, O.
Manufacturers of
Style 508 with safety pulley.
Inquiries solicited.

Arc Lamp Specialties
Trolley Line Material
Creaghead Flexible Brackets
ARE STANDARD.

CROSS ARMS
POLES—TIES

Prompt shipments direct from Mills. Save Brokerages and send us your inquiries.

ECCLESTON LUMBER CO.
29 BROADWAY, NEW YORK.

CENTRAL MANUFACTURING CO.

CHATTANOOGA, TENN.
Manufacturers and Dealers in
YELLOW PINE CROSS ARMS, LOCUST PINS, OAK PINS, ELECTRICAL MOULDINGS, OAK BRACKETS
LARGE STOCKS ON HAND
Delivered prices quoted, F. O. B. cars, your city, in any quantity. *Write us.*

KLEIN'S CLIMBERS.
KLEIN'S LINEMEN'S TOOLS.

WRITE FOR OUR CATALOGUE AND NET PRICES.
WE MAKE LINEMEN'S TOOLS OUR SPECIALTY.

Mathias Klein & Son,
87-89 W. VAN BUREN STREET, CHICAGO, ILL.

Turned Wooden Goods FOR Electrical Purposes

In foreign and domestic wood.

Switch Handles finished in imitation of hard rubber a specialty. Boxes, Bases, Push Buttons, Shells, etc.

UNION HARDWARE CO., Torrington, Conn.

S. C. STROCK,
11 BROADWAY, NEW YORK.

POLES, TIES, TIMBER,

Octagonal and Square Sawn Tapering Poles, Round Poles, Ties, Switch Sets, and other Dimension Stock

FOR ELECTRIC, STEAM AND TRACTION RAILROADS, TELEPHONE, TELEGRAPH AND ELECTRIC COMPANIES

Chestnut Poles

All lengths for Electrical, Telephone, Telegraph, Spiling, Electric and Steam Railroad Ties. Prompt delivery. For prices address

A. L. POTTER & CO.,
18 BROADWAY, NORWICH, CONN

POLES Prompt Delivery CROSS ARMS

The Standard Pole & Tie Co.
42 BROAD ST., NEW YORK

CEDAR POLES

For Railway, Telephone, Telegraph and Electric Light Use. Pine Painted Cross-arms and Oak Pins—Cedar Ties.

Eleven sorting yards in Michigan. Monroe yard nearest customers. We are not Jobbers. Buy of an old, original firm, 20 years in the CEDAR business. Good dispatch.

W. C. STERLING & SON, MONROE, MICH.

POLES TIES

OCTAGONAL AND ROUND
TROLLEY AND STEAM

D. W. PHELAN, 277 Broadway, New York.

CEDAR POLES

THE VALENTINE-CLARK CO., 234 La Salle St., Chicago.

Yards: PINCONNING, MICH. GREEN BAY, WIS. NEW LONDON, WIS.

WHEN YOU WANT

POLES OR TIES

Write us. MALTBY LUMBER CO., Bay City, Mich.

We manufacture best quality Locust Pins
We Sell in Carload Lots
We Guarantee Satisfaction
We Want Your Orders
We Will Send Samples and Prices.

GWYN & POINDEXTER
Elk Creek, Va.

The BRADY MAST ARMS

T. H. BRADY, New Britain, Conn., U. S. A.

Manufacturer of
MAST ARMS, POLE and SWINGING HOODS, HOUSE BRACKETS and other Specialties for Construction Work.

Catalogue and Prices Furnished on Application

INDIANAPOLIS ARM, BRACKET & PIN COMPANY

MANUFACTURERS OF

Cross Arms, Brackets, Locust and Oak Pins

OFFICE:
125 S. MERIDIAN ST., INDIANAPOLIS, IND.
Factory, Jamestown, Ind.

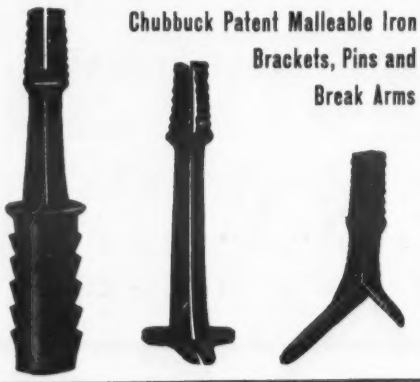
ELECTRICAL WORLD AND ENGINEER secures your audience. Tell them what you have to say clearly and attractively.

ELECTRICAL CONSTRUCTION SUPPLY CO.

SPRINGFIELD, OHIO

Sole Manufacturers of the

Chubbuck Patent Malleable Iron Brackets, Pins and Break Arms



Adjustable Screw End that will not break insulator by variations in temperature. Each device has special features. Will last for years. A new coat of paint when necessary makes them good as new.

Will Not Break. Greatest amount of strength; least material. Weigh one-eighth less than cast iron.

Our illustrated folder describes them in detail.

We shall be pleased to mail a copy to you.

SOMETHING TO THINK ABOUT

Have you considered that if railroad ties, telegraph and telephone poles, cross arms, etc., would give good service for three times their ordinary life, what a substantial increase in dividends it would make? Wood treated by the

HASSELMANN SYSTEM OF IMPREGNATION

will have three to four times the life of the unprotected timber.

It is the only process that insures a thorough, even and complete penetration, even to the innermost core, no matter what may be the size of the timber. The wood is rendered harder and tougher and impervious to atmospheric conditions.

WRITE FOR PAMPHLET.

BARSCHALL IMPREGNATING CO.

31 NASSAU STREET, NEW YORK CITY

DYNAMOS
1-4 K.W. to 10 K.W.

MOTORS
1-16 H. P. to 10 H. P.

Circulars Nos. 7, 8 and 13 give description and an idea of the careful construction of these machines.

A large number of satisfied customers attest to their perfection.

PROTECTED TYPE—DIRECT CURRENT

THE ROBBINS & MYERS CO., SPRINGFIELD, OHIO, U. S. A.
New York Sales Office, 136 Liberty Street.

FOURTH EDITION. OVER 6,000 DEFINITIONS NEWLY ADDED. GREATLY ENLARGED.

A DICTIONARY
OF
ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

Fourth Edition, with 322 double-column Pages added, bringing the work down to 1898. 990 Pages; 582 Illustrations. Price $7.00.

SOME idea of the scope of this important work and of the immense amount of labor involved in it may be formed when it is stated that the Dictionary consists of 990 double column royal octavo pages, includes 10,042 distinct words, terms or phrases, and gives 12,073 different definitions. It also has 582 illustrations, most of which were drawn especially for the work.

Great care has been exercised to secure clearness, to the end that while the definitions and explanations shall be satisfactory to the expert electrician, they shall also be simple and intelligible to those who have little or no training in electricity.

The Dictionary is a handsome book. The type used is large and bold, and so arranged that each word catches the eye at once by standing out in sharp relief from the page.

The volume is convenient in size, the paper of extra quality and the binding handsome and substantial; yet the price has been placed within the means of all.

Copies of this or any other electrical books published will be sent by mail, POSTAGE PREPAID, to any address in the world, on receipt of price.

ELECTRICAL WORLD AND ENGINEER, 120 Liberty Street, New York.

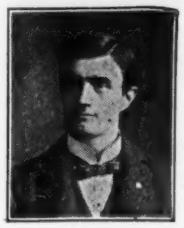
OUR STUDENTS SUCCEED

STUDENT BECOMES ELECTRICIAN.

I enrolled in your Electrical Engineering Course, and began my studies while still attending high school. After leaving school I secured a position with the Goodrich Rubber Co. One year later I accepted a better salaried position with the Morris Mechanical Co., and, before completing Mechanical Drawing, secured my present position as assistant draftsman in the electrical department of the National Steel Co., at a salary 100 per cent better than I ever received before.

WILL H. GRAY,
410 Pike St., Youngstown, Ohio.

HOLDS CIVIL-SERVICE POSITION.



When I first heard of the Schools I was receiving but $30.00 per month as assistant in an electric light plant. I was determined to succeed, and accordingly took up the Electrical Engineering Course. Since that time I have passed four civil-service examinations, and have had my salary raised four times. I now hold a civil-service position at $87.00 per month—nearly three times the wages I received when I began my Course. I can truthfully say that I owe my success to your excellent system of instruction.

ROBT. G. ELLIOTT,
Elec. Engr., Clinton Prison, Dannemora, N. Y.

ELECTRICAL COURSES.

Electrical Engineering; Electrical; Power and Lighting; Electric Railway; Electric Lighting; Telephony; Telegraphy; Wiring and Bell Work.

Electrical instruction in charge of R. B. Williamson, M.E., formerly Professor of Electricity in Lehigh University.

Write for circulars and local references.

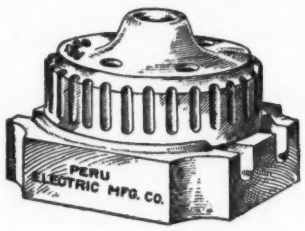
THE INTERNATIONAL CORRESPONDENCE SCHOOLS,
BOX 818, SCRANTON, PA.

CHICAGO INSULATED WIRE COMPANY

FACTORY: Sycamore, Ills. 152 Lake Street, CHICAGO.

A New Rosette Leader

"PEMCO"



The new style Creole Rosette has been especially designed for moulding work. The base being square permits the moulding to be easily fitted to the cut-out. This Rosette is not only ornamental in design but is thorough in every detail as to its electrical and mechanical construction.

The "Pemco" is but one of many of our original electrical porcelain specialties.

WRITE US FOR CATALOGUE.

PERU ELECTRIC MFG. CO.

PERU, INDIANA.

NEW YORK OFFICE: 220 Broadway, F. H. Schlesinger, Sales Manager.

An intending purchaser of electrical apparatus anywhere always consults this paper's advertising pages to ascertain who makes what he wants. ELECTRICAL WORLD AND ENGINEER is recognized in every country of the world as the leading electrical journal.

"CARTWRIGHT" ENCLOSED FUSES

"SHAWMUT" TESTED FUSE LINKS

When you travel 60 miles an hour on the EMPIRE STATE EXPRESS, you don't feel uneasy about your safety; WHY?
Because you have confidence in the management of the road.
So when you have "SHAWMUT" and "CARTWRIGHT" FUSES protecting your electrical machinery, you feel absolutely safe, because you have confidence in their reliability and protection.

Send for Bulletins No. 11 and No. 12.

Sole Manufacturers,

CHASE-SHAWMUT CO.

BOSTON, MASS. [2]

THE BUNNELL

TELEGRAPHIC & ELECTRICAL CO.

110, 112, 114 & 116 Beekman Street

NEW YORK

SOLE MANUFACTURER UNDER THE PATENTS OF JESSE H. BUNNELL

Telegraph Telephones
Electrical and Railway Supplies
Instruments

Batteries, Insulated Wires and Line Equipments
Learners' Outfits.

Send for Catalogue
Learners' Manual on Application

THE

ERICKSON

Outlet and Box Insulators.

The Erickson is the only Insulator having a Metal Thread.

No First-Class

Installation

Can be made without the Erickson Insulators.

We also manufacture Switches, Panel Board Boxes and Plugged Steel Boxes.

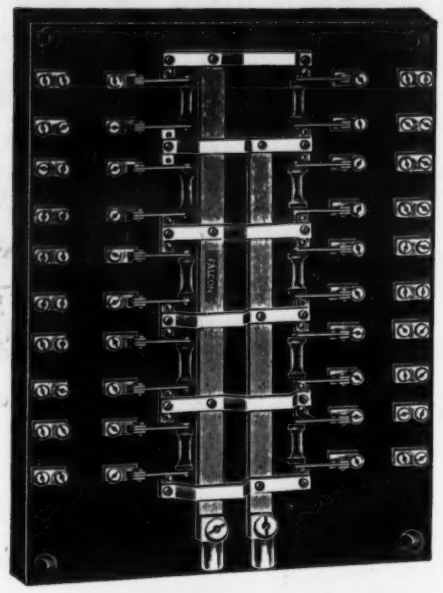
Sole Patentees and Manufacturers.

The Bossert Electric Construction Co.

UTICA, N. Y., U. S. A.

"Falcon" Panel Boards

Fuse Panels, Switch Panels.



Removable Fuse Holder Panels.

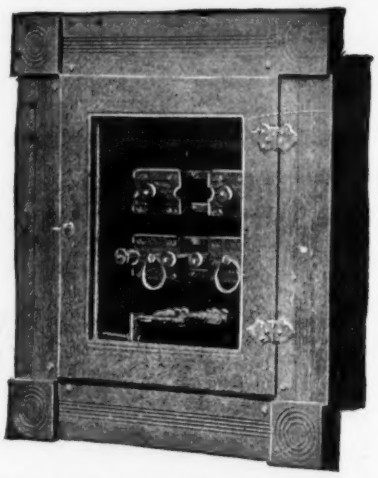
Write for Bulletins Nos. 1, 2, 4, 5 and 6

KNIFE SWITCHES, SWITCHBOARDS

THE FALCON ELECTRIC MANUFACTURING CO.

432-436 EAST 71st STREET, NEW YORK

Cable Address, Falcon New York



New Type Standard Junction Boxes.

Ornamental, Durable, Compact.
Highest Finish.
All Wiring Concealed.
Send for Pamphlet No. 1000.

JOHNSON & MORTON

UTICA, N. Y.

(3)

FASTEN IT ON THE CEILING. . . . OPERATE IT WITH A CORD. Controls either incandescent or arc lamps, no wiring down the walls. It is

THE FAGAN

COMBINATION CUT-OUT AND SWITCH.

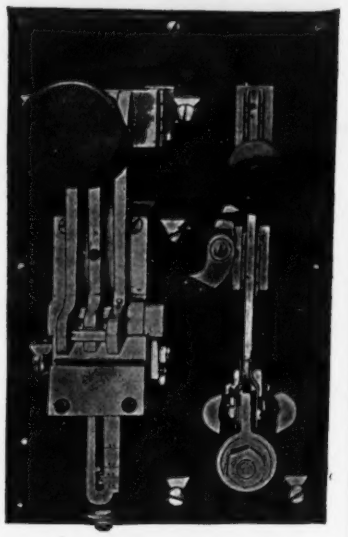
EFFECTIVE. CONVENIENT. FOR SALE BY ALL SUPPLY HOUSES.

Manufactured by J. C. FAGAN, Watertown, N. Y.

ELDEN

CIRCUIT BREAKER

For Alternating Machines



It is placed directly on dynamo, position easy of access.

Breaker will operate far in advance of fuses with absolute certainty.

Short circuit in the collector rings or in the armature leads will open Breaker.

There is no place on the dynamo or circuit where a short circuit is possible, which will not open the Breaker instantly.

Used by the leading electric light companies.

Absolute protection against short circuits and lightning.

—SEND FOR CIRCULAR—

S. B. CONDIT, Jr. & CO.

63 OLIVER STREET, BOSTON, MASS.

Fuse Terminals

for Telephone and Telegraph Cables. Water, Moisture and Lightning-Proof.

Send for Price List.

THE MOON MFG. CO.

43-49 S. Canal St., Chicago, Ill.

PORCELAIN LINED AND.....
JAPANNED CAST IRON.....

Outlet Boxes

H. KRANTZ,

Boerum Place and State Street,

BROOKLYN, N. Y.

THE PIANOPHONE

can be applied to any piano whatever without interfering in the least with its ordinary use or appearance.

Works from either direct current or battery.

Plays artistically any music ever written.

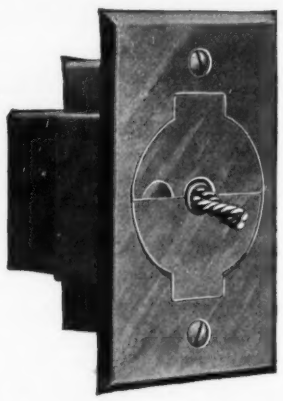
THE PIANOPHONE CO.

Fatory : 249 and 251 Willoughby St. Brooklyn, N. Y.

SOMETHING NEW

The Z. & H. Improved Flush Plug-Receptacle

SOME OF ITS FEATURES



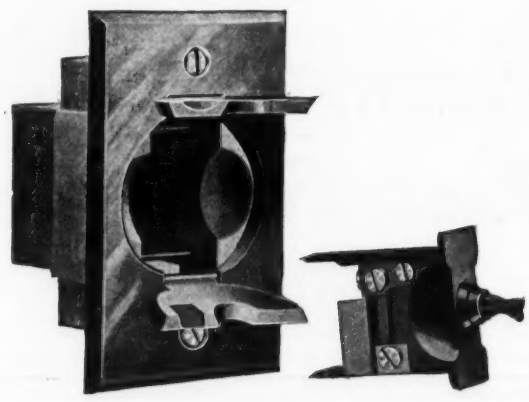
Sets Flush with Surface of Wall or Floor, when Plug is in or out; no Unsightly Plug Projecting beyond the Face.

Has Fuse Connections on both Poles.

Well Fitting Knife Contacts of Large Area.

Handsome and Ornamental in Appearance.

Easily Wired, Substantial Binding Posts at the Front in Separate Compartments being Provided.



MANUFACTURED BY

ZIMDARS & HUNT

127 Fifth Ave., New York

CHICAGO

BADT-GOLTZ ENG. CO.

Monadnock Block

No. 503

"DIAMOND H" SWITCHES

Specify *500 Volt Rotary*

ESPECIALLY DESIGNED FOR ELECTRIC RAILWAY WORK.

No. 503 { *5 Amp. 3 way, 500 Volt* / *10 " " 250 "*

THESE SWITCHES ARE RIGHT IN EVERY PARTICULAR

Send for Catalog A of Push Button Switches

"Diamond H"

HART MANUFACTURING CO. HARTFORD, CONN., U. S. A.

NEW YORK: 203 Broadway. BOSTON: 170 Summer St.

NURSERY STOVE.

Write for Catalogue.

American Electrical Heater Co.,
DETROIT, MICH.

U. S. BATTERY CO.

253 BROADWAY, NEW YORK

Manufacturers of STORAGE BATTERIES and PORTABLE ELECTRIC LAMPS.

Factory and Laboratory: Brooklyn, 552 State St.
Branches: Boston, 19 Pearl St. Chicago, 34 W. Monroe St.

Oxide Storage Batteries for All Purposes.

UNEQUALLED FOR EFFICIENCY, DURABILITY AND CHEAPNESS.

The Oxide Battery Company
Office: No. 1627 North Tenth Street, Philadelphia, Pa.

..NEW.. P & S

PONY RECEPTACLE

EDISON BASE

CUT EXACT SIZE

It is neat in appearance and easily installed. Just the thing for Holiday display.
We will be glad to name you prices.

PASS & SEYMOUR

SYRACUSE, N. Y.

SALES OFFICES:
NEW YORK, CHICAGO, BOSTON, SAN FRANCISCO.

Rheostats
Dimmers
Brushes

WIRT ELECTRIC CO.

1028 Filbert St., Philadelphia, Pa.

SEE OUR LARGER ADVERTISEMENT IN LAST ISSUE OR IN NEXT ISSUE.

HARRISON BROS. & CO.,
PHILADELPHIA. CHICAGO. NEW YORK.

ELECTRIC SOLDERING IRONS.

For Price List write to

UNITED ELECTRIC HEATING CO.
DETROIT, MICH.

ELECTRIC HEATING

BY

EDWIN J. HOUSTON, Ph. D. and A. E. KENNELLY, Sc. D.

(Electro-Technical Series.)

CLOTH. 290 PAGES. 86 ILLUSTRATIONS. PRICE, $1.00.

The comparatively new art of electric heating has shown so marked a development during the last decade that public attention has naturally been directed to this branch of electrical science. The wonderful development in electric street railways has naturally resulted in the introduction of electric heaters on electrically propelled street cars. So, too, the extended introduction of electric lighting in houses and buildings generally has gradually opened the way for apparatus suitable for electric cooking and heating. Nor has the application of stronger electric currents to more powerful heating effects been wanting. Electric welding and the electric shaping and forging of metals, and electric furnaces for the reduction of ores and for the production of various chemical products, have brought into prominence the thermal quality possessed by electric currents. The difficult problem of the electrical heating of conductors will also be found treated in this book in a remarkably simple manner. Like the rest of the series, the book requires no preparation on the part of the reader in mathematics or electrical science for its complete understanding.

Copies of this or any other electrical book published will be sent by mail, postage prepaid, to any address in the world, on receipt of price.

ELECTRICAL WORLD AND ENGINEER, Publishers,
120 LIBERTY STREET, NEW YORK.

PANELS

AND

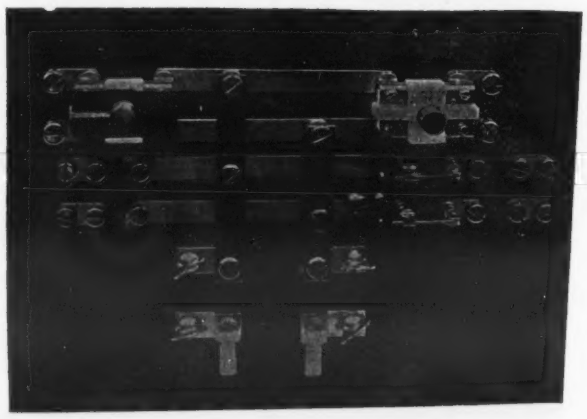
DISTRIBUTING BOARDS

OF ALL KINDS

CIRCUITS

WITH SWITCHES
FUSE HOLDERS
FUSES

Crouse-Hinds Electric Co.



PANEL CABINETS

OF IRON WOOD
MARBLE SLATE

ORNAMENTAL FRONTS

MAIN OFFICE

SYRACUSE, N. Y.

BRANCHES

NEW YORK CHICAGO
BOSTON SAN FRANCISCO

GOULD STORAGE BATTERIES.

SOMETHING ENTIRELY NEW.

Giving **greater** efficiency and **less weight** than any other Storage Battery.

ESPECIALLY ADAPTED FOR

Electric Vehicles,

And

Central Station Lighting and Power,
Electric Elevators,
R. R. Signal Apparatus,
Telegraphs,
Telephones,
Electric Fire Alarms.

SEND FOR DESCRIPTION AND CATALOGUE.....

GOULD STORAGE BATTERY CO.,

N. Y. Office, 25 WEST 33d ST.,

WORKS, DEPEW, N. Y. NEW YORK, N. Y., U. S. A.

THE GORDON CELL

The Most Powerful, Efficient and Economical Primary Battery on the Market for All Purposes.

RAILROAD SIGNALS, TELEPHONES, TELEGRAPHS.

GAS ENGINES, AUTOMOBILES, FIRE, BURGLAR AND POLICE ALARMS.

No. 1 STEEL.

For years, by severe and competitive tests, the Gordon Cell has proved its superiority by **20 PER CENT.** over any other cell.

Made in Ten Different Styles.
Send for Catalogue and Price Lists.

THE GORDON BATTERY CO.,

594 BROADWAY, NEW YORK. (3)

EDISON LALANDE BATTERIES

FOR GAS ENGINES SLOT MACHINES AUTOMOBILES R.R. SIGNALS CROSSING BELLS SMALL MOTORS ETC.

CONSTANT CURRENT NO LOCAL ACTION WILL NOT FREEZE LIQUID TIGHT CELLS FOR PORTABLE WORK.

Full Description In Booklet No. 1.

EDISON MANUFACTURING COMPANY,
135 FIFTH AVE., NEW YORK.

STORAGE BATTERIES

FOR CENTRAL STATION, POWER AND ISOLATED PLANTS.

LONG LIFE,
HIGH EFFICIENCY,
GREAT CAPACITY,

NO CAST PLATES,
NO PERFORATIONS,
NO APPLIED PASTE.

HELIOS-UPTON COMPANY

Address all Communications to

222 FULLERTON AVENUE, CHICAGO, ILLS.

Or To Factories at Philadelphia, Pa., Peabody Mass

SILK

For Electrical Purposes...
Silk for Insulating Finest Wire
ALL KINDS BRAIDING SILK.

WILLIAM RYLE & CO., 54 Howard Street, ...NEW YORK CITY.

Electric Light, Railway and Telephone Supplies.
Best Line in New England.

STUART-HOWLAND CO.,

Telephone—Boston 4144-4127. 283-285 Devonshire Street, BOSTON, MASS.

The most conservative and important daily newspaper in the world is the

LONDON TIMES.

Commenting upon an editorial which appeared in Electrical World and Engineer, the London Times recently said:

"The Electrical World and Engineer "of New York, the leading technical "paper in the United States devoted to "this science, expresses the opinion, "etc."

No matter what country you may visit you will always find Electrical World and Engineer regarded as the leading electrical journal; it stands in a class by itself, the greatest electro-technical journal of the world.

That is the kind of paper you want your advertisement to appear in, because that is the kind of paper the men who have the ordering and the purchasing of electrical supplies **read**: there is a great difference between a paper they **receive** and a paper they **read.** The former **may** do you no good, the latter **must** help you.

Electrical World and Engineer was the first journal to recognize the value of the Export business for the electrical manufacturers of America.

JANUARY 5 EXPORT ISSUE

will be the first issue of the new century and

the best electrical paper ever published.

It will be read and preserved by every man interested in electrical matters.

Cuts and copy wanted Dec. 31.

ELECTRICAL WORLD AND ENGINEER

NEW YORK CHICAGO PHILADELPHIA LONDON

SWEET SIMPLICITY

WHAT COULD BE MORE SIMPLE IN CONSTRUCTION THAN THE LAMP AND YET, EFFICIENCY **MONARC** ENCLOSED ARC UNEXCELLED IN AND ECONOMY.

Old Customers Retained. . . New Ones Gained.

WE REPLACE ALL DEFECTIVE LAMPS WITHOUT CHARGE.

HARDY LAMP CO.,

PITTSFIELD, MASS.

TIN SHADES

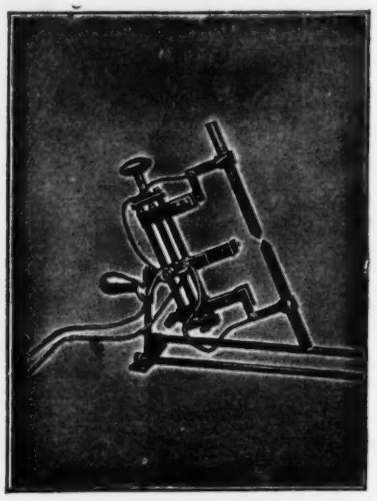
ALL SHAPES AND SIZES FOR EVERY CONCEIVABLE PURPOSE

GOOD TIN GOOD ENAMEL GOOD WORKMANSHIP

Wheeler Reflector Co.

100 Purchase Street Boston, Mass.

The Largest Shade Manufacturers in the World.



HAND-FEED LAMP

...FOR...

Direct or Alternating Currents

Lens Box, Olivette, and Balcony Reflectors for Scenic Effect ....

Chas. J. Bogue

209 Centre Street,

Telephone 2111 Spring NEW YORK

ESCO INCANDESCENT LAMPS

Are the longest life and have the highest efficiency. Guaranteed in every way and very low in cost.

...Write for Catalogue...

We Make FIBRE CONNECTORS WOOD MOULDINGS QUICK SOLDERING PASTE

ELECTRIC SUPPLY CO.

294-296 Dearborn Street CHICAGO

CARBONS. CARBONS. CARBONS.

The "Electra" carbons are the recognized standard all the world over.

FOR ENCLOSED LONG BURNING ARC LAMPS.
TRADE MARK
TRADEMARK
"ELECTRA"
FOR DIRECT CURRENT ARC LAMPS
FOR ALTERNATING CURRENT ARC LAMPS
HIGHEST GRADE NUERNBERG CARBONS
UNEQUALLED IN QUALITY AND EFFICIENCY
ABSOLUTELY STEADY AND BRILLIANT LIGHT.
HUGO REISINGER 11 BROADWAY NEW YORK.

There are no carbons better than the "Electra" and none just as good.

"Manhattan"

STAMPED ON AN ENCLOSED ARC LAMP
...REPRESENTS...

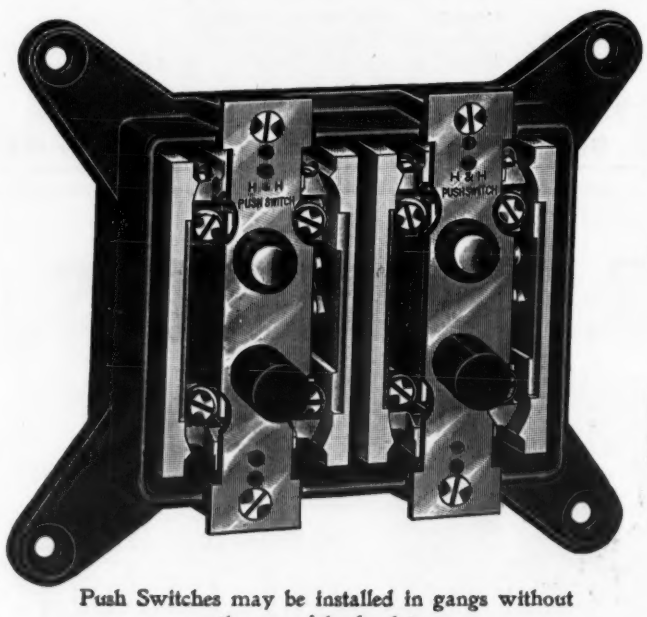
Latest Development
Highest Efficiency
Unequaled Quality

Manufactured for Direct and Alternating Current
Series and Multiple

Manhattan General Construction Co.

Sales Office, 11 Broadway, New York. Newark, N. J.

H. & H. PUSH SWITCH



Push Switches may be installed in gangs without the use of back plates.

THIS SWITCH has a long break. On the double pole the circuit is broken in four places and in the single pole in two. Mechanism is encased in one piece of porcelain.

The contacts are of bronze of Knife Switch form, and the switch plate is thoroughly insulated from the mechanism.

MADE IN FOLLOWING SIZES:

No. 701	10 amp. S. P.	No. 703	10 amp. 3 way.
No. 702	10 amp. D. P.	No. 704	10 amp. 4 way.

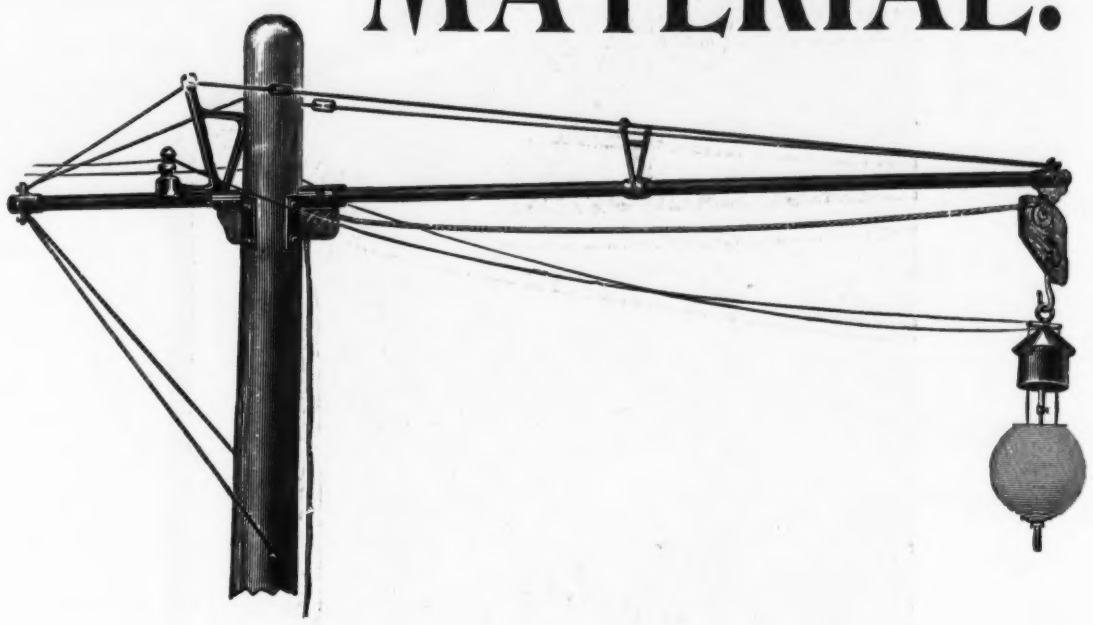
Either for single plates or in gangs of any number up to eight.
Gang plates for more than eight switches made to order.

THE HART AND HEGEMAN MFG. CO.

216 UNION PLACE, HARTFORD, CONN.

(2)

LINE CONSTRUCTION MATERIAL.



WE ARE WESTERN AGENTS FOR

Fletcher's Complete Line of Well Known Specialties

SLEET-PROOF PULLEYS, WIRE HOLDERS, MAST ARMS, REFLECTORS, WINDLASSES, BRACKETS, ARMS, ETC.

We are prepared to make Prompt Shipments from St. Louis Stock.

WESTERN ELECTRICAL SUPPLY CO.

Write us for the most complete Electrical Supply Catalogue ever issued.

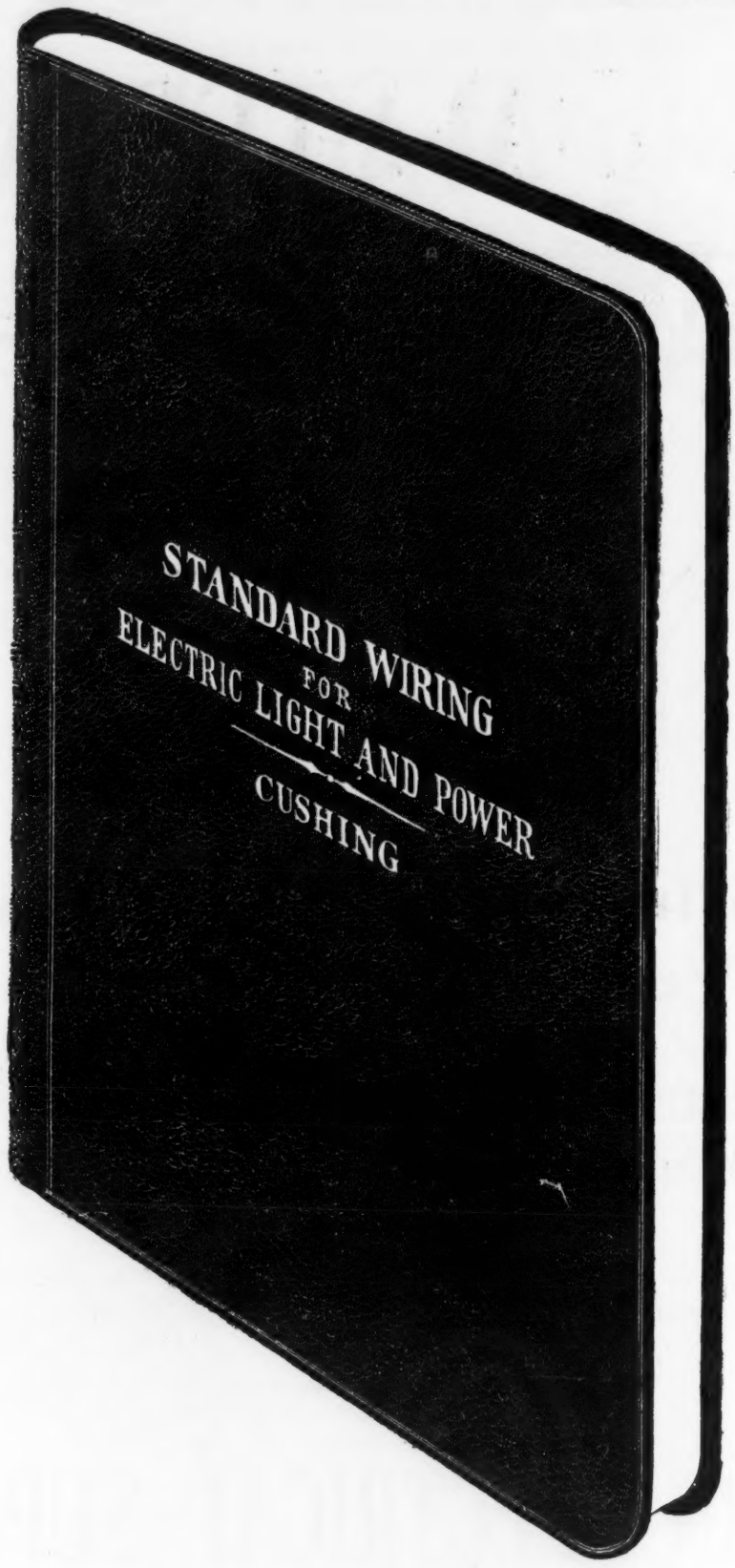
St. Louis, U. S. A.

7th YEAR.
YEARLY AVERAGE, 5,170.

"The Recognized Authority on Wiring and Construction."
—*The Electrical World.*

7th EDITION.
TOTAL COPIES SOLD, 36,180.

By H. C. CUSHING, Jr., A. I. E. E.
Electrical Engineer and Inspector.



Flexible Leather Cover (pocket size) $1.

ADOPTED

By the Fire Underwriters of the United States.
By Cornell University and other leading Technical Colleges and Schools.
By over 36,180 Electrical Engineers, Central Station Managers, Contractors and Wiremen.

BECAUSE

It is the only book on Wiring and Construction kept strictly up to date.
It contains all the necessary Tables, Formulæ and Illustrations, for all systems.
It settles disputes, and if referred to before wiring will prevent disputes.

FOR SALE BY

ELECTRICAL WORLD and ENGINEER
120 LIBERTY STREET
NEW YORK

THE
IDEAL
OF
LAMP PERFECTION.

By its economy, strength, durability and simplicity,
THE STERLING ARC LAMP
has proven itself to be

"BY EVERY TEST THE BEST"

Constant Potential,
3 to 5 Amperes.
Constant Current Series,
5 to 7 Amperes.
Alternating Current,
4 and 6 Amperes.

Our Catalogue gives full description.

STERLING
ARC LAMP CO.,
214-222 West 26th St., New York.

(2)

YOU WILL NOTICE

that our miniature arc lamps have an accessible interior.

You will find that they are wonderfully simple and easy to adjust.

Some of our other points are ornamental appearance, perfect reliability and good light.

These lamps burn directly across 110 and 220 volt direct current circuit, and take 2 1-2 and 1 1-4 amperes, respectively. Fine white light; weight, complete, 10 pounds; length, 17 inches. Carbon life, no guessing, 75 to 80 hours.

You must get our catalog of this and other new type lamps while you think about it.

AGENTS

M. H. BONINGER, Bethovenstr. 80a Frankfurt, Germany.
CHAS. ROSENBAUM, 57 Basinghall Street, London, England.
DAVID CHALMERS, New York City.
VALLEE BROS. ELECTRICAL CO., Philadelphia, Pa.
PITTSBURG ENGINEERING CO., Pittsburg, Pa.
MCCARTHY BROS. & FORD, Buffalo, N. Y.
DAINE ELECTRIC CO., Cleveland, Ohio.
VARNEY ELECTRICAL SUPPLY CO., Indianapolis, Ind.
MCCLEARY & COLQUITT CO., LTD., Detroit, Mich.
RELIABLE ELECTRICAL SUPPLY CO., Chicago, Ill.
FRANK B. THOMPSON, St. Paul, Minn.
JAS. CLARK JR. & CO., Louisville, Ky.
LIPSCOMB & GARRETT, Dallas, Texas.

Lea Electric Mfg. Co.
Box 153 ELWOOD, IND.

THE MOONLIGHT SCHEDULE
FOR 1901

Combining the Frund and Standard Systems.

Additional Copies may be procured for

ONLY 10 CENTS EACH

Electrical World and Engineer
120 Liberty St.,
NEW YORK

Columbia Carbons
FOR ENCLOSED ARCS

Guaranteed superior to any imported carbon in uniformity of size and straightness, or subject to return at our expense; try us and be convinced.

NATIONAL CARBON CO.
1187 W. Madison Ave., Cleveland, O.

ALPHABETICAL INDEX TO ADVERTISERS.

Akron Electric Mfg. Co....58
Alexander, J. S., Mfg. Co....69
American Battery Co....43
American Bell Telephone Co....54
American Bridge Co....64
American District Steam Co....
American Electrical Heater Co....16
American Elec. Heating Corp....
American Electric Fuse Co....53
American Electric Telephone Co....54
American Electrical Works....43
American Engine Co....63
American Min. & Dec. Lamp Co....
American School of Correspondence....
American Steel & Wire Co....
American Stone Conduit Co....6
American Vitrified Conduit Co....2
Anchor Electric Co....33
Anderson Mfg. Co., A. & J. M....19
Arnold Electric Power Station Co....49
Asheville Mica Co....3
Audel & Co., Theo....43
Aultman Co., The....67

Badt-Goltz Eng'g Co....48
Baillard, E. V....72
Baker & Co....3
Ball Electric Co....8
Ball Engine Co....69
Barnaclo, F. W....
Barnes Co., The Wallace....
Barnes Co., W. F. & J....69
Barnett & Co., G. & H....
Barschall Impregnating Co....11
Becken, A. C....6
Becker Eng. Co. A....1
Belden-Larwill Electric & Mfg. Co....29
Beseler Co., Chas....
Besly & Co., Chas. H....72
Bevin Bros. Mfg. Co....6
Biddle, James G....6
Bliss Co., E. W....
Bogart Co., A. L....3
Bogue, Charles J....19
Bossert Electric Construc. Co....14
Bourse, The....3
Bowsher Co., N. P....
Brady, T. H....10
Bristol Company, The....1
Bridgeport Brass Co....1
Brothers, W. F., Co., The....66
Browning Mfg. Co....59
Bruckner Elec. Co., The....53
Buckeye Electric Co....
Bullock Electric Mfg. Co....55
Bullock Mfg. Co., M. C....67
Bunnell & Co., J. H....32
Bunnell Telegraphic & Electrical Co....13
Burch, Edward P....49
Burnham Co., The George....
Burr Mfg. Co., The....67
Burt Mfg. Co....3

Cahoon, James B....49
Camp Co., H. B....6
C. & C. Electric Co....55
Capps Manufacturing Co....54
Carpenter Die & Tap Co., J. M....72
Carleton Electric Co....27
Carlisle & Finch Co....
Cary Spring Works....4
Case Mfg. Co....
C., C., C. & St. L. Ry....
Central Electric Co....
Central Mfg. Co....10
Chaillet, Adolph A....49
Chapman, W. H....
Chase-Shawmut Co....13
Chicago Boiler Cleaner Co....62
Chicago Edison Co....47
Chicago Fuse Wire & Mfg. Co....48
Chicago Insulated Wire Co....13
Chicago Mica Co....26
Cincinnati Milling Machine Co....67
Clark Automatic Telep., S. B., Co., The..51
Cling-Surface Mfg. Co....60
Columbia Incandescent Lamp Co....
Colwell Lead Co....2
Commercial Electric Co....58
Condit, Jr., & Co., S. B....14
Conover Mfg. Co....68
Consolidated Railway Elec. Lt. & Equipment Co....63
Couch & Seeley Co....53
Crane Co....61
Cream Flux Co....46
Creaghead Engineering Co....10
Crocker-Wheeler Co....
Crosby Steam Gage & Valve Co....25
Croselmire, C. F....2
Crouse-Hinds Electric Co....16
Cutler-Hammer Mfg. Co....31
Cutter Electrical & Mfg. Co....1

D. & W. Fuse Co....
Davidson, M. T....68
Dayton Elec'l Mfg. Co....29
Dayton Fan & Motor Co....
Dayton Globe Iron Works Co....32
Dearborn Drug & Chemical Works....62
DeDion-Bouton Motorette Co....70
Delaware Hard Fibre Co....72
Diamond State Fibre Co....2
Diamond Meter Co....4
Directory of Engineers....49
Dixon Crucible Co., Jos....66
Dyer, Edmonds & Dyer....43

Eastern Electric Cable Co....43
Eastern Electric Co....26
Eccleston Lumber Co....10
Eddy Electric Mfg. Co....
Edison Dec. & Min. Lamp Dept....34
Edison Mfg. Co....17
Edwards & Co....29
Electric Appliance Co....34
Electric Contract Co., The....27
Electric Controller & Supply Co....31
Electric Gas Lighting Co....
Electric Launch Co....
Electric Motor & Equipment Co....4
Electric Storage Battery Co....3
Electric Supply Co....19
Electric Vehicle Co....70
Electrical Construction Supply Co....10
Electrical Engineer Inst. of Cor. Inst...43
Electro-Dynamic Co....43
Elwell-Parker Electric Co., The....60
Emerson Elec. Mfg. Co., The....32
Empire China Works....43
Empire Electrical Instrument Co....1
Engineers, Directory of....49
Ericsson Telephone Co....1
Eyanson & Ampriester....2

Fagan, J. C....14
Falcon Elec. Mfg. Co....14
Faries Mfg. Co....2
Federal Battery Co....14
Ferracute Machine Co....68
Ford, Bacon & Davis....49
Ft. Wayne Electric Works....7
Fowler Telephone & Eng'g Co....53
Franklin Portable Crane & Hoist Co....66
Frick Company....
Frink, I. P....25
Fuller Co., The....7

Garl Electric Co....50
Garton, W. R., Co., The....1
Garton-Daniels Co....26
Garvin Machine Co....67
Gen. Incandescent Arc Light Co....25
General Electric Co....9
Gesner, G. W....
Gold Street Car Heating Co....29
Gordon Battery Co....17
Goubert Mfg. Co., The....61
Gould Storage Battery Co....17
Goulds Mfg. Co....68
Grant Tool Co., The....69
Green Fuel Economizer Co....61
Gregory Electric Co....45
Guarantee Electric Co....47
Gwyn & Poindexter....10

Hadaway Elect., Ht. & Eng. Co....7
Hammacher, Schlemmer & Co....50
Hardy Lamp Co....19
Harrisburg Foundry & Machine Wks....63
Harrison Bros. & Co., Inc....16
Hart & Hegeman Mfg. Co., The....20
Hartford Steam Boiler Inspection & Insurance Co....66
Hart Mfg. Co....16
Hartwig & Miller....
Hatch Electric Smelting Co....63
Hazard Manufacturing Co....
Heald & Son, L. S....
Heine Safety Boiler Co....62
Helios-Upton Co....17
Hewitt-Lindstrom Motor Co....70
Hill Brass Co., N. N....6
Hoffman, George W....44
Holmes Fibre-Graphite Mfg. Co....
Holophane Glass Co....72
Horn & Brannen Mfg. Co., The....
Horry, Wm. Smith....49
Houston & Kennelly....49
Humphrey, Henry H....49
Hunt Co., C. W....66
Hunter Machine Co., James....

Ide & Sons, A. L....68
Illinois Maintenance Co., Inc....47
Incandescent Elec. Lt. Manipulator Co....
Indiana Rubber & Ins. Wire Co....1
India Rubber & G. P. Ins. Co....8
Indianapolis Arm, Bracket & Pin Co....10
Inglis, Wm., Wire & Iron Works....2
Insulating Saddle Staple Co....
International Correspondence Schools....13
International Electric Co....3
Ivins, Elwood....68

Jackson, J. P....
Jaeger Miniature Lamp Co....
Jandus Electric Co....
Jantz & Leist....60
Jeffrey Mfg. Co., The....68
Jenkins Bros....1
Jenney Elec. Mfg. Co....8
Jessop & Sons, Wm., Ltd....68
Jewell Electrical Inst. Co....26
Johns Mfg. Co., H. W....5
Johnson & Morton....14
Johnston, Thomas J....43
Jones, Bert C....48
K. & W. Company....
Kartavert Mfg. Co....
Kellogg Switchboard & Supply Co.3 and 52
Kendrick & Davis....31
Keuffel & Esser Co....
Keystone Electric Telephone Co....53
Keystone Electrical Instrument Co....25
Klein & Son, Mathias....10
Klipstein & Co., A....
Knapp Electric & Novelty Co....29
Kneeland Reflector Co....
Knowles, Edward R....
Kokomo Telephone & Elec. Mfg. Co....50
Krantz, H....14

LaKon Co., The....29
LaRoche & Co., F. A....
Latham & Co., E. B....53
Lea Electric Mfg. Co....23
Leclanche Battery Co....3
Leffel & Co., James....32
Lincoln Electric Co....60
Linder & Co., H. J....48
Link Belt Engineering Co....66
Liverpool, London & Globe Ins. Co....60
Locke, Fred M....25
Logan Manufacturing Co....
Lombard Water Wheel Gov. Co....
Lowell Model Works....
Lunkenheimer Co., The....62

McCandless, H. W. & Co....
McCreary, A. A. & Co....2
McDermid Mfg. Co....53
McGowan Co., The John H....68
McIntire Co., The C....3
McIntosh, Seymour & Co....62
McLennon & Co., K....44
McRoy, John T....34
Machado & Roller....25
Mailloux, C. O....49
Maltby Lumber Company....10
Manhattan General Const. Co....20
Manross, F. N....
Marinette Iron Works Mfg. Co....63
Marshall, Wm....72
Marshall-Sanders Co....29
Mayer Elec. Co., M. M....60
Mayo & Rohrer Co....48
Mead, John A., Mfg. Co....66
Merritt Electric Co....
Meyrowitz, E. B....25
Mica Insulator Co....34
Michigan Electric Co....2
Mietz, A....63
Miller-Knoblock Co., The....48
Milwaukee Elec. Co....60
Moloney Electric Co., The....8
Monson Burmah Slate Co., The....
Montauk Multiphase Cable Co....2
Monarch Fire Appliance Co....25
Montgomery & Co....69
Moon Mfg. Co....14
Moore, A. F....1
Munsell & Co., Eugene....34
Murdock Parlor Grate Co....34

National Automatic Telephone Co., The.50
National Carbon Co....23
National Conduit & Cable Co....1
National India Rubber Co....1
National Measured Service Co....53
New Britain Machine Co., The....
New England Butt Co....58
New England Motor Co....60
New Excelsior Dry Battery Manufact'y...
New Process Raw Hide Co., The....72
New York & Ohio Co....1
New York Central R. R....47
New York Insulated Wire Co....1
New York Telephone Co....48
Niles Tool Works Co....70
North Electric Co....52
Northern Electrical Mfg. Co....60
Northern Eng'g Works....
Northwestern Telephone Mfg. Co....53
Norton Electrical Inst. Co....4

Okonite Co., Ltd., The....1
Onondaga Dynamo Co....58
Ostrander & Co., W. R....2
Oxide Battery Co....16

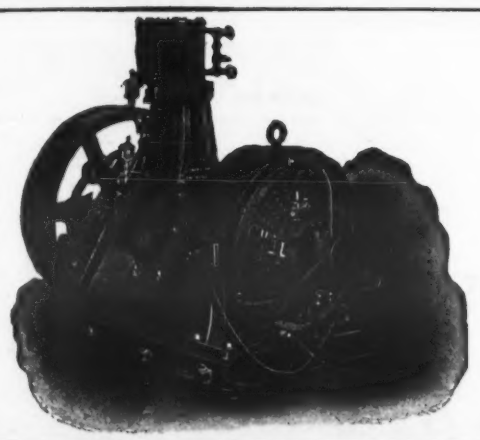
Pacific Electric Co....
Parsell & Weed....72
Patrick, Carter & Wilkins....
Pass & Seymour....16
Peerless Rubber Mfg. Co....60
Pelton Engineering Co....49
Pelton Water Wheel Company....32
Pepper & Register....49
Peru Elec. Mfg. Co....13
Phelan, D. W....10
Phelps Company, The....34
Philadelphia Machine Screw Works....68
Phillips, E. F....43
Phillips Insulated Wire Co....34
Phœnix Glass Co....1
Phosphor-Bronze Smelting Co....67
Pianophone Co., The....14
Pignolet, Louis M....4
Pittsburg Transformer Co....8
Pond Machine Tool Co....70
Potter & Co., A. L....10
Powers Co., E. L., The....49
Pressed Steel Car Co....
Priestman & Co....63
Proposals....46 and 47

Queen & Co., Inc....4
Quimby, William E....68

Rae, Frank B....49
Reid, Thorburn....49
Reidy, J. J....
Reisinger, Hugo....19
Re-New Lamp Co....28
Ridgway Dynamo & Engine Co....
Riker Motor Vehicle Co....1
Ritchie Sons, E. S....72
Robbins & Myers Co., The....12
Roberts Electrical Supply Co., H. C....26
Roche, William....29
Rockwood Mfg. Co....65
Roebling Sons' Co., J. A....7
Rosenbaum, W. A....43
Rossiter, MacGovern & Co....45 and 47
Roth Bros. & Co....
Royal Electric Company....8
Rushmore Dynamo Works....72
Russell-Tomlinson Electric Co., The....53
Ryle & Co., Wm....17

Sage & Bro., F. B....4
Samson Cordage Works....34

Continued on Page 26.



Our Generating Sets

FOR MARINE OR SMALL ISOLATED PLANTS

COMPACT AND LIGHT WEIGHT — ARE DURABLE — HIGH GRADE AND EFFICIENT

WE ALSO MANUFACTURE A COMPLETE LINE OF

GENERATORS AND MOTORS

[3] Send for Bulletin W.

THE TRIUMPH ELECTRIC CO., - Cincinnati, O.

POWER TRANSMISSION AT 60,000 VOLTS

Made Possible by the use of

LOCKE "VICTOR"

Type Insulators, Tested at Factory to 120,000 Volts

Adopted by the

Bay Counties Power Co.
Standard Elec. Co. of Cal.

For the Longest and Highest Voltage Lines in the World

FRED M. LOCKE - VICTOR, N. Y., U. S. A.

Send for Catalogue No. 5 and ask for Surface Leakage Tests

JOHN MARTIN & CO., 33 New Montgomery St., San Francisco, Cal., Pacific Coast
WM. E. PECK & CO., 100 William St., New York, Australia, Mexico So. America
GUIDO TOLUSSO, Via Torino 61, Milan, Italy.

One and one-half million Locke Insulators in daily use

"NOTHING SUCCEEDS LIKE SUCCESS"

Frink's Special Store Window Reflector

PATENTED— April 20, 1897. Feb. 21, 1899.

Manufactured by
I. P. FRINK,
551 Pearl St.,
...New York.

After using this reflector in the show windows of the May Shoe and Clothing Store, in Denver, and "The Famous," in St. Louis, The May Company have installed it in the five stories of show windows of their Cleveland store, which is the most remarkable store front at night in the world. Could this reflector have a stronger endorsement? Full information sent on request. (2)

THE WHITNEY

Current and Potential Indicators are accurate, well made and thoroughly reliable.

Prices right. Full data sent on application to

MACHADO & ROLLER,
203 Broadway, New York, N. Y.

General Selling Agents of
Whitney Electrical Instrument Co.

Kilfyre

DRY POWDER COMPOUND

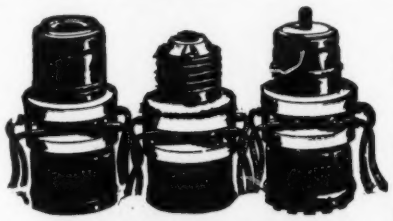
IDEAL FIRE PROTECTION

FOR SWITCHBOARDS AND ALL ELECTRICAL APPARATUS.

MONARCH FIRE APPLIANCE CO.,
27 WILLIAM ST., NEW YORK.

AWARDED TWO BRONZE MEDALS

AT THE PARIS EXPOSITION



Made in Parallel or in Series.

Just think how easy it is to obtain the use of two lights and a fan motor from a one-lamp bracket. Place a

VETTER CURRENT TAP

in the wall bracket, replace the lamp and carry the conducting cords to the desk or drop light and fan motor, and there you are.

All the simple device costs is One Dollar, and surely you'll never regret the small outlay.

Send for Descriptive Circular and Discount Sheet.

E. B. MEYROWITZ, Manufacturer and Patentee,

104 E. 23d Street, New York. Also at 125 West 42d Street.

604 Nicollet Ave., Minneapolis. 3 Rue Scribe, Paris, France. 360 St. Peter St., St. Paul.

Keystone Electrical Instrument Co.

WE MAKE and CARRY IN STOCK **A FULL LINE OF SWITCHBOARD AND PORTABLE INSTRUMENTS**

INCLUDING

Voltmeters, Ammeters,

for both direct and alternating currents.

POLARITY INDICATORS AND ARC LIGHT VOLTMETERS AND GROUND DETECTORS. . . . .

" COMBINATION PORTABLES."

Available for both direct and alternating current.

CHICAGO: 315 Dearborn St.
NEW YORK: 15 Cortlandt St.
BOSTON: 170 Summer St. (2)

901 Montgomery Ave., PHILADELPHIA.

GENERAL INCANDESCENT ARC LIGHT CO.

Factory and General Offices: 572-578 FIRST AVENUE, NEW YORK.

TRADE **G. I.** MARK.

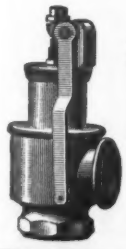
Manufacturers of HIGH-GRADE ELECTRICAL SUPPLIES.

WRITE FOR ATTRACTIVE BULLETINS.

BRANCH OFFICES

Chicago, Ill.	48 West Jackson Boulevard.	Minneapolis, Minn.	516 Guaranty Building.
Philadelphia, Pa.	522 Drexel Building.	Denver, Colo.	621 16th Street.
Boston, Mass.	31 Milk Street.	Cincinnati, Ohio	57 Perin Building.
St. Louis, Mo.	638 Century Building.	San Francisco, Cal.	598 Perrott Building.
Cleveland, Ohio	39-47 East Prospect Street.	Export Department, N. Y.	572-578 First Avenue.
Milwaukee, Wis.	408 Uihlein Building.		

:-: :-: CROSBY STEAM GAGE AND VALVE CO. :-: :-:



APPROVED and ADOPTED BY THE U. S. GOVERNMENT.

Crosby Pop Safety Valves

ARE A PERFECT PROTECTION FROM EXCESS OF STEAM PRESSURE.

STEAM ENGINE INDICATORS,
GAGE TESTERS,
PRESSURE GAGES,
VACUUM GAGES,
ORIGINAL SINGLE BELL,
CHIME WHISTLES,
FEED WATER REGULATORS,
WATER RELIEF VALVES,
BRANDEN RUBBER
PUMP VALVES,
LUBRICATORS, ETC.

SPRING-SEAT GLOBE AND ANGLE VALVES.

All Working Parts Renewable.

GUARANTEED NOT TO LEAK

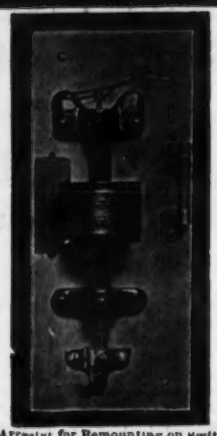
AT HIGH PRESSURES.

MADE YOKE OR PLAIN TOP.

Iron or Brass Bodies. (1)

Stores: 95 Oliver St., BOSTON. 78 JOHN ST., NEW YORK. 21-23 W. Lake St., CHICAGO. 75 Queen Victoria St., LONDON.

Office and Works, BOSTON, MASS.


Station Arrester for Remounting on Switchboard

THIS IS A GOOD TIME

to find the device best suited to your requirements and bank account.
Maybe you won't need them until Spring, but

Garton Lightning Arresters

are always **Good Property**—they don't deteriorate, and if you are properly equipped you can't help feeling better about it.

GARTON-DANIELS COMPANY, Keokuk, Ia., U. S. A.

ALPHABETICAL INDEX TO ADVERTISERS.—*Continued from Page 24.*

Sangamo Electric Co.....7
Sargent & Lundy.....49
Sawyer-Mann Electric Co.....
Schieren & Co., Chas. A.....1
Schmidt, The Lambert, Tel. Mfg. Co.....50
Schoonmaker, A. O.....2
Schureman & Hayden.....47
Sebastian Lathe Co.....69
S. E. I. Co.....
Seneca Falls Mfg. Co.....69
Sheaff & Jaastad.....49
Shelby Electric Co.....3
Shultz Belting Co.....1
Siegrist Lubricator Co.....62
Siemens & Halske Electric Co.....27
Simplex Electrical Co.....1
Simplex Interior Telephone Co.....50
Sittman & Pitt.....69
Smethurst & Allen.....49
Smith, A. T.....
Smith Co., S. Morgan.....33
Sprague Electric Co.....55
Standard Paint Co., The.....34
Standard Pole & Tie Co., The.....10
Standard Stamping & Die Co.....43
Standard Telephone & Electric Co.....54
Standard Underground Cable Co.....
Standard Welding Co., The.....
Stanley Electric Mfg. Co.....60
Stanley Instrument Co.....2
Stephenson Mfg. Co.....67
Sterling Arc Lamp Co.....23
Sterling & Son, W. C.....10
Sterling Electric Co.....
Sterling Electric Motor Co.....
Sterling Varnish Co.....34
Steward Mfg. Co., D. M.....34
Stewart & Co., Frank H.....10
Stewart Electrical Co.....46
Stilwell-Bierce & Smith-Vaile Co.....33
Storage Battery Supply Co.....72
Storey General Electric Co.....
Stow Mfg. C.....69
Strock, S. C.....10
Stromberg-Carlson Tele. Mfg. Co.....52
Stuart-Howland Co.....17
Stucky, Jacob.....43
Sturtevant Co., B. F.....59
Swarts Metal Refining Co.....48
Swedish-American Tele. Co.....54
Thayer, Lester R.....49
Thomas & Sons Co., R.....68
Thompson, Edw. P.....43
Thompson, Son & Co.....46
Three Rivers Electric Co.....60
Toerring Co., C. J.....31
Toomey, Frank.....46
Townsend & Decker.....43
Triumph Electric Co.....24
Union Hardware Co.....10
Union Porcelain Works.....
U. S. Battery Co.....16
United States Carbon Co., The.....1
United Electric Heating Co.....16
Utica Fire Alarm Telegraph Co.....53
Valentine-Clark Co.....10
Varley Duplex Magnet Co.....50
Vezin Machine Co.....61
Viaduct Mfg. Co.....50
Victor Electric Co.....
Victor Telephone Works.....50
Vilter Mfg. Co.....
Vitro-Chrome Chemical Co.....72
Vose, Ralph.....48
Vulcanized Fibre Co.....2
Wagner Elec. Mfg. Co.....57
Wagner, Herbert A.....49
Walsh's Sons & Co.....48
Want and For Sale Ads.....44 to 48
Ward Leonard Electric Co.....31
Warren, A. K.....49
Warren Electric & Specialty Co.....9
Warren Elec. Mfg. Co.....59
Washburn Shops, The.....68
Watson-Stillman Co.....69
Webster Chemical Co.....43
Western Electric Co.....5
Western Electrical Supply Co.....21
Western Telephone Cons. Co.....50
Westinghouse, Church, Kerr & Co.....71
Westinghouse Electric & Mfg. Co.....71
Westinghouse Machine Co.....71
Weston Electrical Instrument Co.....72
Wheeler Reflector Co.....19
White & Co., J. G.....49
White Co., O. C.....2
Whitney Elec. Inst. Co.....21
Willyoung, Elmer G.....4
Wirt Electric Co.....16
Woodward Governor Co.....
Woodward & Rogers Co., The.....
Wright & Craycroft.....3
Zimdars & Hunt.....15

EASTERN LAMPS EXCEL OTHERS

In care of manufacture,
In accuracy of sorting,
In length of service,
In moderation of price.

Ask us, as to prices;
Ask our customers, as to quality.
Send trial order—Test the lamps;
Then you will surely buy of us.

Every lamp guaranteed.

EASTERN ELECTRIC CO., BOSTON, MASS.

CHICAGO MICA COMPANY

AMBER

INDIA

VALPARAISO, IND.
MANUFACTURERS
CRYSTAL VARNISH AND CHAMPION PAINTS

H·C·ROBERTS ELECTRIC SUPPLY CO.

831 ARCH ST., PHILADA., PA.
THE BEST GOODS AT FAIR PRICES

SWITCHBOARD INSTRUMENT

STANDARD INSTRUMENTS

Best in the World

Milli-Ammeters, Milli-Voltmeters, Ammeters, Voltmeters

IN SWITCHBOARD AND PORTABLE STYLES

Send for New Descriptive Price List for June 1st, 1900

JEWELL ELECTRICAL INSTRUMENT CO.

203 Pontiac Bldg., CHICAGO, ILL., U. S. A.

F. B. SAGE & BRO.

123 LIBERTY ST., NEW YORK — NEW YORK SALES AGENTS

Siemens & Halske Electric Company of America,

REPAIR PARTS FURNISHED FOR ALL APPARATUS

OF

OUR MANUFACTURE.

ADDRESS - - HOME OFFICE

FORT WAYNE, - - - INDIANA.

OR ANY OF THE FOLLOWING

BRANCH OFFICES.

BOSTON, MASS., 518 Exchange Bldg.
PHILADELPHIA, PA., 101 The Bourse.
SYRACUSE, N. Y., 717 Dillaye Bldg.
PITTSBURG, PA., 902 Fifth Ave.
CINCINNATI, OHIO, 402 Neave Bldg.
ATLANTA, GA., 8 S. Broad St.
ST. LOUIS, MO., 818 Lincoln Trust Bldg.
CHICAGO: ILL., 623 Marquette Bldg.
ST. PAUL, MINN., 615 Germania Life Bldg.
GRAND RAPIDS, MICH., 230 Houseman Bldg.

SAVES ITS ENTIRE COST IN ONE YEAR!

THE PANSIGNAL

(Patented in United States, Great Britain, France and Germany.)

TYPE "B,"

Designed for Hotels, Apartments, Etc.

Simultaneously transmits from room and RECORDS in office

Any one of 500 different orders
The room number
Time the order is given
Number of portions desired, from 1 to 6.

The receiving instrument is entirely automatic, requiring neither annunciator nor attendant.

Orders are classified in a booklet, with ready reference margin tags.

Examine all other alleged hotel "systems." See how little they do and how inaccurately they do that little. Then come and test the Pansignal.

CARLETON ELECTRIC CO.

1133 Broadway - - - - NEW YORK.

CLASSIFIED INDEX.

ANNUNCIATORS.
Garl Elec. Co.
Electric Appliance Co.
Electric Gas Lighting Co.
Ostrander & Co., W. R.
Partrick, Carter & Wilkins.

ASBESTOS.
Johns Mfg. Co., H. W.

AUTOMOBILES.
DeDion-Bouton Motorette Co.
Electric Vehicle Co.
Hewitt-Lindstrom Motor Co.
Knapp Elec. & Novelty Co. (Min.).
Riker Motor Vehicle Co.

BATTERIES, PRIMARY.
Badt-Goltz Eng'g Co.
Bunnell & Co., J. H.
Edison Mfg. Co.
Electric Gas Lighting Co.
Federal Battery Co.
Gordon Battery Co.
Harrison Bros. & Co., Inc.
Kendrick & Davis.
Leclanche Battery Co.
New Excelsior Dry Battery Mfy.
Peru Electric Mfg. Co.
Roche, William.
Victor Electric Co.
Western Electric Co.

BATTERIES, STORAGE.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.
Oxide Battery Co.
Storage Battery Supply Co.
U. S. Battery Co.

BELLS.
Bevin Bros. Mfg. Co.
Edwards & Co.
Electric Gas Lighting Co.
Hill Brass Co., The, N. N.
Ostrander & Co., W. R.
Utica Fire Alarm Tel. Co.
Viaduct Mfg. Co.

BELTING.
Schieren & Co., Chas. A.
Schultz Belting Co.

BELT DRESSING.
Cling-Surface Mfg. Co.
Dixon Crucible Co., Joseph.
Stephenson Mfg. Co.

BLOWERS.
Sturtevant Co., B. F.

BOILERS.
Heine Safety Boiler Co.
Smith Co., S. Morgan.

BOILER CLEANERS.
Chicago Boiler Cleaner Co.

BOILER COMPOUNDS.
Dearborn Drug & Chemical Co.

BOILER INSPECTION.
Hartford Steam Boiler In. & Inspec. Co.

BOOKS, TECHNICAL.
Audel & Co., Theo.
Electrical World and Engineer.
Powers Co., The E. L.

BORING TOOLS.
Hartwig & Miller.

BRAIDING MACHINES.
New England Butt Co.

BRASS GOODS.
Crane Co.

BRIDGES, ROOFING, FLOORS (Iron).
American Bridge Co.

BRUSHES, DYNAMO.
Holmes Fibre-Graphite Mfg. Co.
K. & W. Co.
Wirt Electric Co.

CABLE HANGERS.
Chase-Shawmut Co.
Johns Mfg. Co., H. W.
Standard Underground Cable Co.

CABLING MACHINES.
New England Butt Co.

CAR HEATERS, ELECTRIC.
American Electric Heating Corp.
Gold Street Car Heating Co.
Johns Mfg. Co., H. W.
Simplex Electrical Co.

CAR LIGHTING, ELECTRIC.
Consolidated Railway Electric Lighting & Equipment Co.

CARBON POINTS AND PLATES.
National Carbon Co.
Reisinger, Hugo.
U. S. Carbon Co., The.

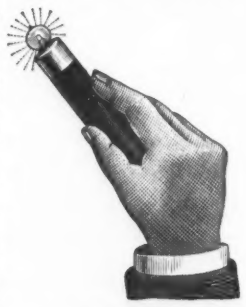
CASTINGS.
Logan Mfg. Co.
New England Butt Co.
Smith Co., S. Morgan.

CIRCUIT BREAKERS.
Condit, Jr., & Co., S. B.
Cutler-Hammer Mfg. Co.
Cutter Electrical & Mfg. Co.
La Roche & Co., F. A.
Ward Leonard Electric Co.

CLIMBERS.
Klein & Son, Mathias.
Reidy, J. J.

COME-ALONGS.
Burr Mfg. Co., The.

Continued on Page 28.



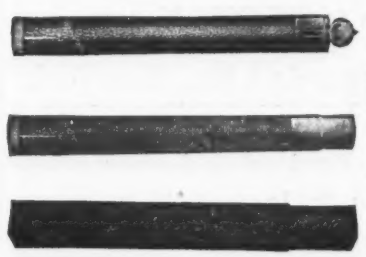
"Light of Asia" Lamps

A SMALL, HANDSOME, PORTABLE ELECTRIC LIGHT.

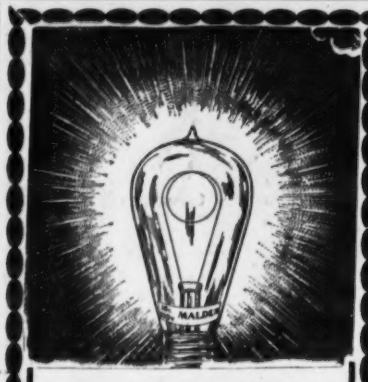
Gives a bright light and is absolutely free from fire danger.
Always ready, the batteries are guaranteed for one year not to deteriorate unless used, and are easily renewed.

No. 1, 7-8 inch diameter, 8 1-8 inches long, weighs 5 oz.
No. 5, 1 1-4 inch diameter, 8 1-8 inches long, weighs 10 oz.
No. 10, 1 9-16 inch diameter, 9 5-8 inches long, weighs 20 oz.

Our "Clover Leaf" Test Batteries do not leak or explode and are commercially permanent.
Send for Circular.



ELECTRIC CONTRACT CO., 61 Elm St., NEW YORK



WE RENEW BURNED-OUT LAMPS

and guarantee every renewal!

There's a clean saving of 40 per cent.—the cost of material—in our proposition for you; or if you would rather sell your burned-out Lamps

WE WILL BUY

or exchange

WRITE FOR PARTICULARS
PROMPT ATTENTION....

RE-NEW LAMP CO.

126 State Street
BOSTON - MASS.

ECO

Door Openers, Door Switches.
Electro Mechanical Gongs.
The Vigilant Bell.
Midget Pushes.
Burglar Alarms. Annunciators.
Door and Window Springs.
The "RECTI" Automobile Bell.

Edwards & Co., New York.

You can reach everyone in the electrical field whose attention it is possible to secure through a newspaper by advertising in ELECTRICAL WORLD AND ENGINEER.

CLASSIFIED INDEX.—*Continued from Page 27.*

COMMUTATOR BARS.
Miller-Knoblock Elec. Mfg. Co.

COMMUTATOR COMPOUND.
K. & W. Co.
McLennan & Co., K.

CONDENSERS.
Conover Mfg. Co.
Davidson, M. T.
Marshall, Wm. (Electric).
Stilwell-Bierce & Smith-Vaile Co.

CONDUITS.
American Stone Conduit Co.
American Vitrified Conduit Co.
Camp Co., H. B.
McKoy, John T.
National Conduit & Cable Co.
Sprague Electric Co.
Standard Underground Cable Co.
Western Electric Co.

CONNECTORS—FIBRE.
Electric Supply Co.

CONNECTORS AND TERMINALS.
McIntire Co., The C.

CONSTRUCTION TOOLS.
Klein & Son, Mathias.

CONVEYING MACHINERY.
Aultman Co., The.
Brothers Co., W. F., The.
Case Mfg. Co.
Hunt Co., C. W.
Jeffrey Mfg. Co.
Link-Belt Engineering Co.
Mead Mfg. Co., John A.
Niles Tool Works Co.

CORD.
American Steel & Wire Co.
Moore, Alfred F.
Samson Cordage Works.

CRANES AND HOISTS.
Aultman Co., The.
Case Mfg. Co.
Franklin Portable Crane & Hoist Co.
Jeffrey Mfg. Co.
Niles Tool Works Co.

CONTROLLERS.
Electric Controller & Supply Co., The.
Schureman & Hayden.
Three Rivers Elec. Co.

CROSS ARMS.
Central Mfg. Co.
Eccleston Lumber Co.
Locke, Fred M.
Standard Pole & Tie Co., The.
Sterling & Son, W. C.

CURRENT TAPS.
Meyrowitz, E. B.

CUT-OUTS.
Anchor Electric Co.
Fagan, J. C.
Marshall-Sanders Co.

DRAWING MATERIALS.
Alexander Mfg. Co., J. S.
Keuffel & Esser Co.

DRILL GRINDERS.
Heald & Son, L. S.
Washburn Shops, The.

DYNAMOS AND MOTORS.
Akron Electric Mfg. Co.
American Engine Co.
Ball Elec. Co.
Browning Mfg. Co., The.
Bullock Electric Mfg. Co.
C & C Electric Co.
Chapman, W. H.
Commercial Electric Co.
Crocker-Wheeler Co.
Dayton Elec'l Mfg. Co.
Eddy Electric Mfg. Co.
Electro-Dynamic Co.
Elwell-Parker Electric Co.
Emerson Electric Mfg. Co.
Falcon Elec. Mfg. Co.
Ft. Wayne Electric Works.
General Electric Co.
General Incandescent Arc Light Co.
Gregory Electric Co.
Guarantee Electric Co.
Jantz & Leist Electric Co.
Jenney Electric Mfg. Co.
Jeffrey Mfg. Co.
Kendrick & Davis.
La Roche & Co., F. A.
Lincoln Electric Co.
Linder & Co., H. J.
Mayo & Rohrer Co.
Mayer Elec. Co., M. M.
Milwaukee Electric Co.
New England Motor Co., The.
Northern Electrical Mfg. Co.
Onondaga Dynamo Co.
Pelton Engineering Co.
Ridgway Dynamo & Engine Co.
Robbins & Myers Co., The.
Rossiter, MacGovern & Co.
Roth Bros. & Co.
Royal Electric Co.
Rushmore Dynamo Works.
Schureman & Hayden.
Siemens & Halske Electric Co.
Sprague Elec. Co.
Stanley Elec. Mfg. Co.
Sterling Electric Motor Co.
Storey General Electric Co.
Stow Mfg. Co.
Sturtevant Co., B. F.
Thompson, Son & Co.
Three Rivers Elec. Co.
Triumph Electric Co.
Victor Electric Co.
Wagner Electric Mfg. Co.
Warren Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

ELECTRIC HEATING DEVICES.
American Electric Heating Corp.
American Electrical Heater Co.
Gold Street Car Heating Co.
Hadaway Elect. Heating & Eng. Co.
Johns Mfg. Co., H. W.
Simplex Electrical Co.
Standard Welding Co., The.
United Electric Heating Co.

ELECTRIC LAUNCHES.
Electric Launch Co.

ELECTRIC LEATHER BELTING.
Schieren & Co., Chas. A.

ELECTRIC LIGHT MANIPULATORS.
Incan. Electric Lt. Manip. Co.

ELECTRIC MINE LOCOMOTIVES.
Jeffrey Mfg. Co.

ELECTRIC LOCKS.
Carleton Electric Co.

ELECTRIC SIGNS.
Michigan Electric Co,

ELECTRICAL INSTRUMENTS.
Badt-Goltz Eng'g Co.
Biddle, James G.
Bunnell & Co., J. H.
Diamond Meter Company.
Electric Motor & Equipment Co.
Empire Electrical Inst. Co.
Ft. Wayne Electric Works.
General Incandescent Arc Light Co.
Gregory Electric Co.
International Electric Co.
Jewell Electrical Instrument Co.
Keystone Electrical Inst. Co.
Machado & Roller.
Norton Electrical Inst. Co., The.
Pignolet, Louis M.
Queen & Co., Inc.
Sage & Bros., F. B.
S. E. I. Co.
Siemens & Halske Electric Co.
Stanley Instrument Co.
Westinghouse Electric & Mfg. Co.
Weston Electrical Inst. Co.
Whitney Electrical Inst. Co.
Willyoung, Elmer G.
Wirt Electric Co.

ELECTROMAGNETS.
Varley Duplex Magnet Co.

ENGINEERS AND CONTRACTORS.
Arnold Electric Power Station Co.
Badt-Goltz Eng'g Co.
Burch, Ed. P.
Cahoon, James B.
Ford, Bacon & Davis.
Houston & Kennelly.
Humphrey, Henry H.
Jackson, J. P.
Knowles, Edward R.
Mailloux, C. O.
Pelton Engineering Co.
Pepper & Register.
Potter & Benson.
Rae, Frank B.
Reid, Thorburn.
Sargent & Lundy.
Sheaff & Jaastad.
Smethurst & Allen.
Thayer, R., Lester.
Wagner, Herbert A.
Warren, A. K.
Westinghouse, Church, Kerr & Co.
White Company, J. G.

ENGINES, GAS.
Marinette Iron Works Mfg. Co.
Mietz, A.
Northern Engineering Works.

ENGINES, OIL.
Mietz, A.
Priestman & Co.

ENGINES, STEAM.
American Engine Co.
Ball Engine Co.
Bullock Mfg. Co., M. C.
Frick Co. (Corliss and Automatic).
Harrisburg Foundry & Machine Works.
Ide & Sons, A. L.
Leffel & Co., James.
Linder & Co., H. J.
Mayo & Rohrer Co.
McIntosh, Seymour & Co.
New Britain Machine Co., The.
Ridgway Dynamo & Engine Co.
Sturtevant Co., B. F.
Vilter Mfg. Co.
Vezin Mch. Co.
Westinghouse Machine Co.

EXHAUST HEADS.
Burt Mfg. Co.
Sturtevant Co., B. F.

FANS AND FAN MOTORS.
Dayton Fan & Motor Co.
Falcon Electric Mfg. Co.
Fuller Co., The.
Gen. Inc. Arc Lt. Co.
Knapp Electric & Novelty Co.
Robbins & Myers Co., The.
Sprague Electric Co.
Stuart-Howland Co.
Sturtevant Co., B. F.
Warren Electric & Specialty Co.

FEED WATER HEATERS.
Goubert Mfg. Co.
Stilwell-Bierce & Smith-Vaile Co., The.

FIBRE.
Diamond State Fibre Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co., The.
Vulcanized Fibre Co.

FILES, RASPS, ETC.
Barnett Co., G. & H.

FIRE APPLIANCES.
Monarch Fire Appliance Co.

FIXTURES (Gas and Electric).
White Co., The O. C.

FLEXIBLE SHAFTS.
Stow Mfg. Co.

FORGES.
Sturtevant Co., B. F.

FRICTION CLUTCHES.
Smith Co., S. Morgan.

FUEL ECONOMIZERS.
Green Fuel Economizer Co.

FUSES.
American Electric Fuse Co.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Co.
General Electric Co.
Johns Mfg. Co., H. W.
McIntire Co., The C.
Moon Mfg. Co.

GAGES, STEAM.
Crosby Steam Gage & Valve Co.

GAS LIGHTING APPARATUS.
Bogart Co., The A. L.
Electric Gas Lighting Co.
Ostrander & Co., W. R.
Smith, A. T.

GEARS.
Smith Co., S. Morgan.

GLOBES, SHADES, ETC.
Faries Mfg. Co.
Frink, I. P.
Holophane Glass Co.
McCreary, A. A.
Kneeland Reflector Co.
Phœnix Glass Co.
Wheeler Reflector Co.

GONGS.
Bevin Bros. Mfg. Co.
Hill Brass Co., The, N. N.

HEATING APPARATUS.
Sturtevant Co., B. F.

HEATING BY EXHAUST STEAM.
American District Steam Co.

HOUSE GOODS.
Electric Gas Lighting Co.

ICE MAKING MACHINERY.
Vilter Mfg. Co.

IGNITERS, GAS ENGINE.
Carlisle & Finch Co., The.
Dayton Elec'l Mfg. Co.
Roche, William.

IGNITION PLUGS FOR GAS ENGINES.
Roche, William.

INDUCTION COILS.
International Electric Co.
Ostrander & Co., W. R.
Varley Duplex Magnet Co.

INSTRUMENTS (Testing and Recording).
Akron Elec. Mfg. Co.
Badt-Goltz Eng'g Co.
Biddle, James G.
Bristol Co.
Diamond Meter Co.
Electric Motor & Equipment Co.
Empire Electrical Inst. Co.
Ft. Wayne Electric Works.
General Electric Co.
General Incandescent Arc Light Co.
Gregory Electric Co.
Jewell Electrical Instrument Co.
Keystone Electrical Instrument Co.
Machado & Roller.
Norton Electrical Inst. Co., The.
Queen & Co.
Sage & Bros., F. B.
Sangamo Elec. Co.
S. E. I. Co.
Siemens & Halske Electric Co.
Stanley Instrument Co.
Vose, Ralph.
Wagner Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.
Weston Electrical Inst. Co.
Willyoung, Elmer G.
Whitney Electrical Inst. Co.
Wirt Electric Co.

INSULATORS AND INSULATING MATERIAL.
American Steel & Wire Co.
Anchor Electric Co.
Anderson Mfg. Co., A. & J. M.

Continued on Page 30.

TRANSFORMERS

For any voltage or frequency. High potential testing transformers. Step up and step down transformers for long distance transmission.

VENTILATED TYPE. OIL TYPE.

THE LAKON COMPANY, Elkhart, Ind., U. S. A.

THE "AUTOGAS" DRY BATTERY

For Automobiles, Gas and Gasoline Engines, Launches, etc.

The New Standard Double Porcelain Insulated Ignition Plug.

Any size battery made to operate the system. Dry Automobile cell, same size as the French cell, guaranteed superiority, 400 per cent, $5.00 per set of four. Send for complete catalogue.

WILLIAM ROCHE, Manufacturer and Sole Inventor "New Standard" Dry Battery.

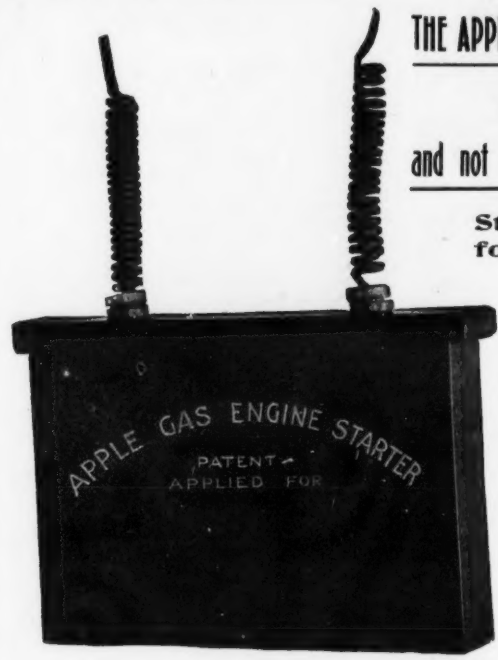
42 VESEY ST., NEW YORK

THE APPLE DUPLEX STORAGE BATTERY

FOUR VOLTS

and not a joint in the entire battery.

Storage Batteries for any purpose.



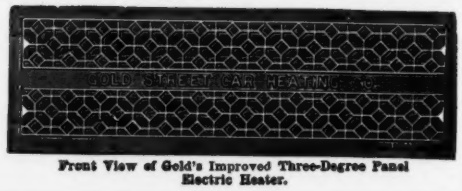
Gas Engine Igniting Dynamos, Magnetos, and everything pertaining to economical gas engine ignition.

THE DAYTON ELECT. MFG. CO., DAYTON, O.

Gold's Electric Heaters.

Improved Construction.
Highest Efficiency.
WRITE FOR Simple and Compact.
PARTICULARS. Greatest Economy.
Acknowledged everywhere without an equal.

GOLD STREET CAR HEATING CO.,
Frankfort and Cliff Sts., N. Y.
658 Rookery, Chicago.



Front View of Gold's Improved Three-Degree Panel Electric Heater.

The first and most important point about advertising is to select the right medium. If you want to do business with any man in the electrical field in any part of the world, the right medium to advertise in is Electrical World and Engineer.

ARC LAMPS.

Long-Burning.
Enclosed Arc.
Mechanically Correct.
Handsome Appearance.

Gives a Brilliant, Steady Light, with no hissing or simmering.

THE BELDEN-LARWILL Electric and Manufacturing Co.
FORT WAYNE, IND., U. S. A.

HIGH GRADE PUSH BUTTON SWITCHES

MARSHALL-SANDERS CO. BOSTON.

LITTLE HUSTLER MOTOR

$1.

A VARIETY OF

Holiday Specialties

TO $5.00

Handled by Supply Houses the World over. Catalog for the asking.

Knapp Electric & Novelty Co.

127 WHITE STREET, NEW YORK

Ornamental Lamp for Indoor Service.

It Would Seem Ridiculous

To put an Ornamental Lamp in a foundry.

It would seem equally foolish to spend thousands of dollars in obtaining artistic interiors, and then spoil the whole by placing an ugly lamp—the foundry kind—in the very centre of it all.

We can furnish the right lamp for the right place, and at the right price.

Correspondence solicited.

C. J. TOERRING CO.

1035 Ridge Avenue, Philadelphia, Pa., U. S. A.

NEW YORK:

Geo. Stanmore, 115 Broadway

CLASSIFIED INDEX.—*Continued from Page 28.*

Bunnell & Co., J. H.
Delaware Hard Fibre Co.
Empire China Works.
Ft. Wayne Electric Works.
Insulating Saddle Staple Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Locke, Fred M.
Mica Insulator Co.
Munsell & Co., Eugene.
Pass & Seymour (China).
Peru Elec. Mfg. Co.
Ryle & Co., Wm. (Silk).
Standard Paint Co.
Standard Underground Cable Co.
Sterling Varnish Co.
Steward Mfg. Co., D. M.
Thomas & Sons, R.
Union Hardware Co.
Union Porcelain Works.
Vulcanized Fibre Co.
Ward Leonard Electric Co.

JACKS.
Watson-Stillman Co.

JUNCTION BOXES.
Bossert Electric Const. Co.
General Incandescent Arc Light Co.
Johnson & Morton.
Krantz, H.

LAMP COLORING COMPOUNDS.
Vitro-Chrome Chemical Co.
Webster Chemical Co.

LAMPS, ARC.
Anderson Mfg. Co., A. & J. M.
Badt-Goltz Eng'g Co.
Ball Electric Co.
Belden-Larwill Electric & Mfg. Co.
Bogue, C. J. (Photographic).
General Electric Co.
General Incandescent Arc Light Co.
Gregory Electric Co.
Guarantee Electric Co.
Jandus Electric Co.
Lea Electric Mfg. Co.
Linder & Co., H. J.
Machado & Roller.
Manhattan General Const. Co.
Pelton Engineering Co.
Sterling Arc Lamp Co.
Toerring Co., C. J.
Western Electric Co.
Western Electric Supply Co.
Westinghouse Electric & Mfg. Co.

LAMPS, INCANDESCENT.
Buckeye Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Columbia Incandescent Lamp Co.
Eastern Elec. Co.
Edison Dec. & Min. Lamp Dept.
Electric Contract Co.
General Electric Co.
General Incandescent Arc Light Co.
Guarantee Electric Co.
Hardy Lamp Co., The.
Machado & Roller.
Merritt Elec. Co.
New York & Ohio Co.
Pelton Engineering Co.
Phelps Co., The.
Re-New Lamp Co.
Sawyer-Man Electric Co.
Shelby Electric Co.
Warren Electric & Specialty Co.
Western Electric Co.

LAMP CORD, ADJUSTER.
Stewart & Co., Frank H.

LAMP GUARDS.
Wm. Inglis Wire & Iron Wks.

LAMPS, MINIATURE.
Amer. Min. & Decorative Lamp Co.
Edison Dec. & Min. Lamp Co.
McCandless & Co., H. W.

LEAD.
Colwell Lead Co.

LIGHTNING ARRESTERS.
Connecticut Tele. & Electric Co.
Garton-Daniels Co.
Viaduct Mfg. Co.
Westinghouse Elec. & Mfg. Co.

LUBRICATORS.
Crane Co., The.
Lunkenheimer Co., The.
Siegrist Lubricator Co.

MACHINE TOOLS, ETC.
Barnes Co., W. F. & John.
Bement, Miles & Co.
Besly & Co., Charles H.
Bliss Co., E. W.
Burnham Co., The Geo.
Cincinnati Milling Machine Co.
Ferracute Machine Co.
Garvin Machine Co.
Grant Tool Co.
Heald & Son, L. S.
Montgomery & Co.
Niles Tool Works Co.
Philadelphia Machine Screw Works.
Pond Machine Tool Co.
Sebastian Lathe Co.
Seneca Falls Mfg. Co.
Washburn Shops, The.
Watson-Stillman Co.
Woodward & Rogers Co.

MARINE ELECTRIC EQUIPMENT.
Eddy Electric Mfg. Co.
Electro-Dynamic Co.

MAST ARMS.
Brady, T. H.
Creaghead Eng'g Co.

MECHANICAL DRAFT.
Sturtevant Co., B. F.

MEDICAL APPARATUS.
Pignolet, Louis M.

METAL POLISH.
Hoffman, George W.

METAL REFINING.
Swarts Metal Refining Co.

MICA.
Asheville Mica Co.
Chicago Mica Co.
Johns Mfg. Co., H. W.
Mica Insulator Co.
Munsell & Co., Eugene.
Schoonmaker, A. O.

MILLING MACHINES.
Bement, Miles & Co.
Cincinnati Milling Machine Co.

MINING MACHINERY.
Bullock Mfg. Co., M. C.

MODEL MAKERS.
Baillard, E. V.
Capps Manufacturing Co.
International Electric Co.
Parsell & Weed.
Standard Stamping & Die Co.

MOTOR CLOTH AND INSULATING PAPERS.
Standard Paint Co.

MOULDING, ELECTRICAL.
Electric Supply Co.
Wright & Craycroft.

NAME PLATES.
Becker Eng. Co., A.
Murdock Parlor Grate Co.

OIL AND GREASE CUPS.
Besly & Co., Charles H.
Crane Co., The.
Lunkenheimer Co., The.

OIL FILTERS AND PURIFIERS.
Burt Mfg. Co.

PACKING.
Jenkins Bros.
Peerless Rubber Mfg. Co.

PAINTS, VARNISHES, ETC.
Standard Paint Co.
Sterling Varnish Co.

PATENT ATTORNEYS.
Barnaclo, F. W.
Dyer, Edmonds & Dyer.
Johnston, Thomas J.
Rosenbaum, Wm. A.
Thompson, E. P.
Townsend & Decker.

PIANOPHONES.
Pianophone Co., The.

PINIONS.
New Process Raw Hide Co.

PLATINUM.
Baker & Co.
Croselmire, C. F.

POLES, TIES, BRACKETS, PINS, ETC.
Brady, T. H.
Central Mfg. Co.
Creaghead Eng'g Co.
Eccleston Lumber Co.
Electrical Const. Supply Co.
Gwyn & Poindexter.
Indianapolis Arm, Bracket & Pin Co.
Maltby Lumber Co.
Phelan, D. W.
Potter & Co., A. L.
Pressed Steel Car Co.
Standard Pole & Tie Co., The.
Sterling, W. C., & Son.
Strock, S. C.

PORCELAIN MANUFACTURERS.
Empire China Works.
Locke, Fred M.
Pass & Seymour.
Peru Electric Mfg. Co.
Thomas & Son, R.
Union Porcelain Works.

PRESSES, DIES AND SPECIAL MACHINERY.
Bement, Miles & Co.
Bliss Co., E. W.
Ferracute Machine Co.
Hunter Machine Co., The Jas.
Pond Machine Tool Co.
Watson-Stillman Co.

PULLEYS, SHAFTINGS, COUPLINGS, ETC.
Aultman Co., The.
Hunter Machine Co., The Jas.
Jeffrey Mfg. Co.
Rockwood Mfg. Co.
Smith Co., S. Morgan.

PUMPS, ELECTRIC.
Commercial Electric Co.
Goulds Mfg. Co., The.
Quimby, Wm. E.

PUMPS, STEAM.
Davidson, M. T.
Goulds Mfg. Co., The.
McGowan Co., The J. H.
Stilwell-Bierce & Smith-Vaile Co., The
Quimby, Wm. E.

Continued on Page 32.

PUMP VALVES, RUBBER.
Crosby Steam Gage & Valve Co.

PUNCHES AND SHEARS.
Bliss Co., E. W.
Bement, Miles & Co.
Ferracute Machine Co.

RAIL BONDS.
American Steel & Wire Co.
Roebling Sons' Co., J. A.

RAILWAY SUPPLIES (Electric).
Central Electric Co.
Garl Electric Co.
General Electric Co.
Johns Mfg. Co., H. W.

RECEPTACLES.
Electro-Dynamic Co., The.
Falcon Elec. Mfg. Co.
General Incandescent Arc Light Co.

REFLECTORS.
Frink, I. P.
Holophane Glass Co.
Kneeland Reflector Co.
McCreary & Co., A. A.
Murray & Co., James J.
Pacific Elec. Co.
Phœnix Glass Co.
Wheeler Reflector Co.

REFRIGERATING MACHINERY.
Vilter Mfg. Co.

REPAIRING.
Chicago Edison Co. Repair Shops.
Gregory Electric Co.
Guarantee Electric Co.
Lincoln Electric Co.
Michigan Electric Co.
Stewart Electrical Co.
Stucky, Jacob.
Warren, A. K.

RHEOSTATS.
American Electric Heating Corp.
Cutler-Hammer Mfg. Co.
General Incandescent Arc Light Co.
Schureman & Hayden.
Simplex Electrical Co.
Ward Leonard Electric Co.
Wirt Electric Co.

ROSETTES.
Hart Mfg. Co.
Pass & Seymour.
Union Hardware Co.

SAL AMMONIAC.
Klipstein & Co.

SCHOOLS AND COLLEGES.
American School of Correspondence.
Electrical Engineer Inst. of Correspondence Inst., The.
International Correspondence Schools.

SCREWS.
Philadelphia Machine Screw Works.
Sittman & Pitt.

SEARCHLIGHTS.
Bogue, Charles J.
Carlisle & Finch Co., The.
Rushmore Dynamo Works.

SECOND-HAND APPARATUS.
Gregory Electric Co.
Guarantee Electric Co.
Illinois Maintenance Co.
Mayo & Rohrer Co.
Linder & Co., H. J.
Pelton Engineering Co.
Rossiter, MacGovern & Co.
Stewart Electrical Co.
Thompson, Son & Co.
Toomey, Frank.

SIGNALING APPARATUS.
Carleton Electric Co.

SILK.
Ryle & Co., Wm.

SLATE.
Monson Burmah Slate Co., The.

SMELTERS.
Hatch Elec. Smelting Co., The.

SOCKETS.
General Electric Co.
Johns Mfg. Co., H. W.
Marshall-Sanders Co.
Pass & Seymour.

SOLDERING PASTE.
Cream Flux Co.
Electric Supply Co.

SPRINGS.
American Steel & Wire Co.
Barnes Co., Wallace.
Cary Spring Works.
Hammacher, Schlemmer & Co.
Manross, F. N.

STEAM ENGINE INDICATORS.
Crosby Steam Gage & Valve Co.

STEEL PINS.
Locke, Fred M.

STEREOPTICONS.
Beseler Co., Chas.

STOKERS.
Westinghouse, Church, Kerr & Co.

EMPIRE

Electric Lamps and Novelties.

Candelabra and Miniature Lamps a Specialty.

Catalogue and Price List on Application.

H. W. McCANDLESS & CO.

79 Cortlandt St.

NEW YORK

The men with whom you wish to do business are readers of ELECTRICAL WORLD AND ENGINEER.

Rex Motor, $1.00

The Top Notch of Perfection

A copy of "Electrical Units for Boys" is sent with each motor. Send for complete catalogue F of Battery Motors, Measuring Instruments and Medical Coils.

KENDRICK & DAVIS
Lebanon, N. H.

A History of Wireless Telegraphy

By J. J. FAHIE

Cloth, 12mo, 325 pages. *Ill.*
PRICE, *TWO DOLLARS*

...An interesting, timely, and valuable volume on the new art, full of references with dates, to inventors in this field, and including Lodge's and Branly's Papers, Marconi English patents, etc., the work of Edison, Preece, Dolbear, Trowbridge and others. Should be ordered at once. Sent to any address, postage free, on receipt of price, by ...

Electrical World *and* Engineer
120 Liberty St., New York City

EVERY DYNAMO FIELD RHEOSTAT

which we make and sell is intended to sell more as a result of its operation. A large number have been sold in that way and more and more are being sold, as those already in service are proving their worth in hard, every-day use. If you want to be sure of getting a reliable rheostat and one that is guaranteed to give satisfaction, get a **C. & H.**

THE CUTLER-HAMMER MFG. CO.

Main Offices and Factory, MILWAUKEE, WIS.

Eastern Factory, WESTFIELD, N. J. **N. Y. Office, 136 LIBERTY ST.**

The Largest and oldest exclusive Manufacturers of Electric Controlling Devices in the World.

THOROUGH VENTILATION

A controller hasn't any hair to fall out, but free and uniform ventilation is a big advantage, just the same.

A controller that is thoroughly ventilated will successfully withstand a larger amount of current than one that is not ventilated.

The most perfectly ventilated controller made is the Dinkey Ventilated—resistance is practically strung in air—can be run red hot.

This construction adds greatly to its life and efficiency, and is one of the strong points that places it ahead of other controllers on the market.

Other important features are: The magnetic blow-out with which this controller is now equipped, ease of installation, durability, low cost for keeping in repair.

Write to-day for catalogue and full particulars. (4)

THE ELECTRIC CONTROLLER & SUPPLY CO.
Mfrs. & CONSULTING ELECTRICAL ENGINEERS - CLEVELAND, O.

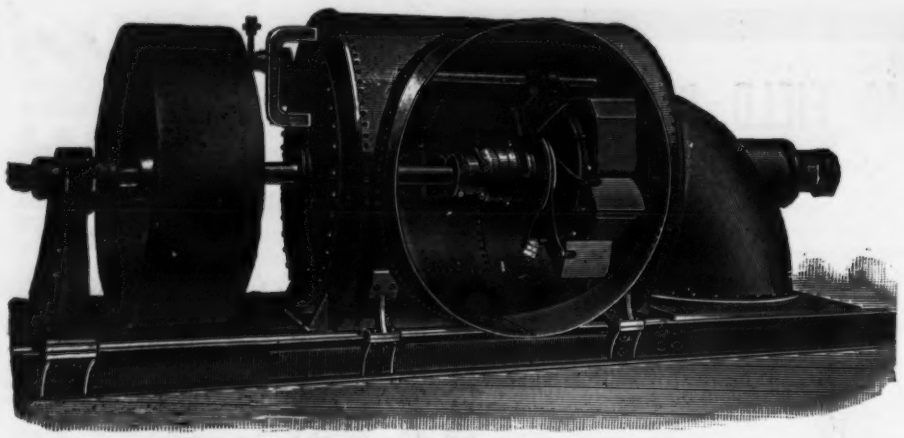
BOOKS

ON ANY ELECTRICAL SUBJECT sent, prepaid, to any address in the world, upon receipt of price.

Send for Catalogue.

ELECTRICAL WORLD AND ENGINEER, 120 Liberty Street, N. Y.

WARD LEONARD GOLD MEDAL RHEOSTATS AND CIRCUIT-BREAKERS



The
New American Turbine
FOR
ELECTRIC POWER TRANSMISSION
STATE YOUR REQUIREMENTS AND SEND FOR CATALOGUE.

The **Dayton Globe Iron Works Co.,**
90 S. Ludlow Street,
DAYTON. OHIO, U. S. A.

CLASSIFIED INDEX.—*Continued from Page 30.*

SUPPLIES, GENERAL ELECTRICAL.
Anchor Electric Co.
Bunnell & Co., J. H.
Bunnell Teleg. & Elec'l Co.
Central Electric Co.
Edwards & Co.
Electric Appliance Company.
Electric Supply Co.
Fowler Telephone & Eng'g Co., The.
Garl Electric Co.
Garton Co., W. R.
General Electric Co.
Gregory Electric Co.
Michigan Electric Co.
Pelton Engineering Co.
Roberts Elec. Supply Co., H. C.
Stuart-Howland Co.
Western Electric Co.
Western Electrical Supply Co.

SWITCHBOARDS.
American Elec. Telephone Co.
Anderson Mfg. Co., A. & J. M.
Badt-Goltz Eng'g Co.
Bruckner Electric Co., The.
Couch & Seeley Co.
Crouse-Hinds Electric Co.
Electro-Dynamic Co., The.
Emerson Elec. Mfg. Co.
Eyanson & Armpriester.
Falcon Elec. Mfg. Co.
Garl Elec. Co.
General Incandescent Arc Light Co.
Guarantee Electric Co.
Kellogg Switchboard & Supply Co.
Keystone Electric Telephone Co.
Kokomo Telephone & Electric Mfg. Co.
La Roche & Co., F. A.
Sterling Electric Co.
Utica Fire Alarm Telegraph Co.
Wagner Electric Mfg. Co.
Western Telephone Construction Co.

SWITCHES, ETC.
Anchor Electric Co.
Anderson Mfg. Co., A. & J. M.
Badt-Goltz Eng'g Co.
Central Electric Co.
Chase-Shawmut Co.

VALVES.
Crane Co.
Crosby Steam Gage & Valve Co.
Crouse-Hinds Electric Co.
Cutter Electrical & Mfg. Co.
Electro-Dynamic Co., The.
Eyanson & Armpriester.
Fagan, J. C.
Falcon Elec. Mfg. Co.
Garl Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Hart & Hegeman Mfg. Co.
Hart Mfg. Co.
La Roche & Co., F. A.
Marshall-Sanders Co.
Sterling Electric Co.
Western Electrical Supply Co.
Western Telephone Construction Co.
Zimdars & Hunt.

TAPS AND DIES.
Carpenter Tap & Die Co., J. M.

TELEPHONES.
American Bell Telephone Co.
American Electric Telephone Co
Bruckner Electric Co., The.
Clark Automatic Telephone Switchboard Co., The.
Couch & Seeley Co.
Ericsson Telephone Co.
Garl Electric Co.
Kellogg Switchboard & Supply Co.
Keystone Electric Telephone Co.
Kokomo Tele. & Elec. Mfg. Co.
National Automatic Telephone Co., The.
North Electric Co.
Northwestern Telephone Mfg. Co.
Russell-Tomlinson Elec. Co., The.
Schmidt Telep. Mfg. Co., The Lambert.
Standard Tele. & Elec. Co.
Stromberg-Carlson Tele. Mfg. Co.
Viaduct Mfg. Co.
Swedish-American Telephone Co.
Victor Telephone Works.
Western Telephone Construction Co.

TELEPHONE METERS.
National Measured Service Co., The.

WOOD PRESERVING.
Barshall Impregnating Co.

TELEPHONE SUPPLIES.
Bunnell & Co., J. H.
Couch & Seeley Co.
Ericsson Telephone Co.
Garl Electric Co.
Kellogg Switchboard & Supply Co.
National Measured Service Co., The.
Russell-Tomlinson Electric Co.
Schmidt Telep. Mfg. Co., The Lambert.
Simplex Interior Telephone Co., The.
Sterling Electric Co.
Western Telephone Construction Co.

TELEGRAPHIC INSTRUMENTS.
Bunnell & Co., J. H.
Bunnell Teleg. & Elec'l Co.

THEATRE DIMMERS.
American Electric Heating Corp.
Cutler-Hammer Mfg. Co.
Simplex Electrical Co.
Ward Leonard Electric Co.
Wirt Electric Co.

TRACTION SYSTEMS.
General Electric Co.

TRANSFORMERS.
Diamond Meter Co.
Ft. Wayne Electric Works.
Garton Co., W. R.
Gregory Electric Co.
Guarantee Electric Co.
LaKon Co., The.
Moloney Elec. Co.
New York & Ohio Co.
Pittsburg Transformer Co., The
Royal Electric Co.
Siemens & Halske Electric Co.
Wagner Electric Mfg. Co.
Warren Electric & Specialty Co.
Westinghouse Electric & Mfg. Co.
Western Electrical Supply Co.

TUBING.
Ivins, Ellwood.

Jenkins Bros.
Lunkenheimer Co., The.

VULCABESTON.
Johns Mfg. Co., H. W.

VULCANIZED FIBRE.
Vulcanized Fibre Co.

WATCHES, NON-MAGNETIC.
Becken, A. C.

WATER WHEELS.
Dayton Globe Iron Works.
Leffel & Co., James.
Pelton Water-Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce & Smith-Vaile Co.

WATER-WHEEL GOVERNORS.
Lombard Water-Wheel Gov. Co.
Stilwell-Bierce & Smith-Vaile Co.
Woodward Governor Co.

WIRES AND CABLES.
American Electrical Works.
American Steel & Wire Co.
Bridgeport Brass Co.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Electric Appliance Company.
Garton Co., W. R.
Hazard Mfg. Co.
Indiana Rubber & Ins. Wire Co.
India Rubber & G. P. Ins. Co.
McDermid Mfg. Co., The.
Montauk Multiphase Cable Co.
Moore, A. F.
National Conduit & Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips, E. F.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Underground Cable Co.
Western Electrical Supply Co.

EMERSON FAN MOTORS
Catalogue Showing New Types for Season of 1901 will soon be issued
You should see the new Emerson Line before buying. Write for Catalogue
Eastern Office and Warehouse
136 Liberty Street
NEW YORK CITY
THE EMERSON ELECTRIC MFG. CO.
7-4-716-718 St Charles Street
ST. LOUIS, MO., U. S. A

IN WRITING TO ADVERTISERS Subscribers will confer a favor on us and also on the advertisers by mentioning that they saw the advertisement in ELECTRICAL WORLD AND ENGINEER.

ESTABLISHED 1878 **J. H. BUNNELL & CO.** INCORPORATED 1899
20 PARK PLACE, Near General Post Office, NEW YORK.

TRADE MARK.

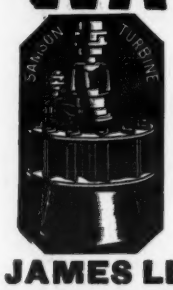
Manufacturers, Importers and Dealers in Telegraph, Telephone, Railway and Electric Lighting Apparatus and Supplies, Instruments, Batteries, Insulated Wires and Line Equipment.

Catalogues and Circulars Free on Application. Get our Special Prices Before Placing Orders Elsewhere.

We own the GOOD-WILL, NAME, COPYRIGHTS, TRADE-MARKS, Patent No. (288881) and all other assets of the old firm of J. H. BUNNELL & CO., and propose to maintain our rights in the premises.

J. H. BUNNELL & CO.
20 PARK PLACE, - Near General Post Office, - NEW YORK

WATER WHEELS
For Heads of 3 Feet to 2000 Feet.



Recent Holyoke tests enable us to guarantee:
The Largest Power ever obtained from a wheel of the same dimensions. The highest speed ever obtained for the same power. The highest mean efficiency ever realized when running from half to full gate. We guarantee also: A runner of the greatest possible strength. A gate unequaled in quickness and ease of opening and closing. A special adaptation to all kinds of

ELECTRIC POWER AND LIGHTING PLANTS

Tests show over 81 per cent. average efficiency with half to full quantity water. State your head and write for pamphlet.

JAMES LEFFEL & CO., Springfield, Ohio, U.S.A.

THE PELTON WATER WHEEL COMPANY
gives exclusive attention to the development and utilization of water powers by the most modern, economic and improved methods.

An experience of more than fifteen years, involving both the theory and practice of hydraulic engineering as relates to power development in its widest range of application, is at the service of its customers. NINE THOUSAND WHEELS NOW RUNNING, aggregating some 700,000 H. P.

ELECTRIC POWER TRANSMISSION...
Pelton Wheels afford the most reliable and efficient power for such service, and are running the majority of stations of this character in the United States, as well as most foreign countries.

Highest efficiency and absolute regulation guaranteed under the most extreme variations of load. Catalogues furnished on application. Address

PELTON WATER WHEEL COMPANY,
121 Main Street, San Francisco, Cal., U. S. A.
143 Liberty Street, New York City, U. S. A.

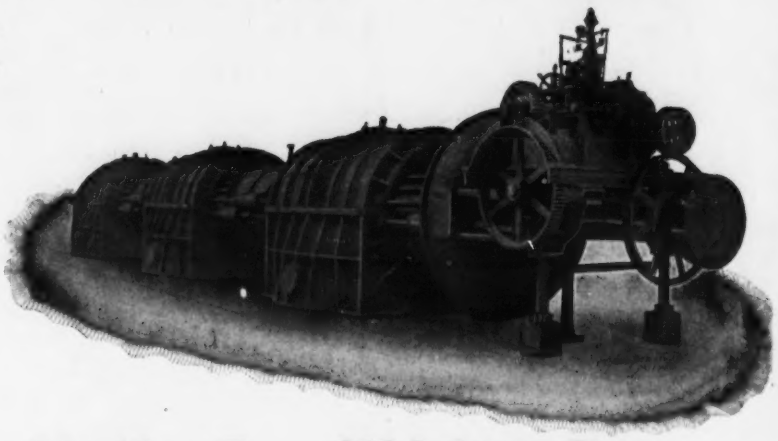
Victor Turbines Operating Dynamos

That there are more Victor Turbines in use supplying Power for Electric Generators than any other is due to the many points of superiority possessed by this Turbine.

FEATURES WORTH REMEMBERING:

High Speed, ***Close Regulation,***
Great Capacity, ***High Efficiency,***
Perfect Cylinder Gate, ***Steady Motion.***

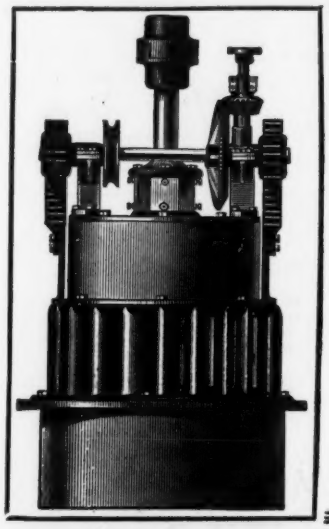
We also have a full line of modern patterns for Gears and Power Transmission machinery.



WRITE FOR CATALOGUE.

Stilwell-Bierce & Smith-Vaile Co., 262 Lehman St., Dayton, Ohio.

NEW YORK OFFICE: 141 BROADWAY.



THE McCORMICK TURBINE.

Features

Worth Consideration:
Great Capacity, High Speed, Unequalled Efficiency,
Steady Motion, Easy Working Gate,
Greatest Power from a Limited Quantity of Water, at Smallest Cost.

UNDOUBTEDLY THE MOST POPULAR TURBINE MANUFACTURED.

S. MORGAN SMITH COMPANY,

WRITE FOR CATALOGUE. YORK, PA., U. S. A.

SOCKETS

WE SOLD OVER A HALF MILLION LAST YEAR

More than all other New England Supply Dealers Combined

A E L Co—G E Co—BRYANT

ANCHOR ELECTRIC CO., Manufacturers and Dealers,

71 FEDERAL ST., BOSTON. G. O. Proctor, Pres. and Treas. G. H. Proctor, Gen. Mgr.

An Intending Purchaser

of Electrical Apparatus anywhere always consults this paper's advertising pages to ascertain who makes what he wants. **ELECTRICAL WORLD AND ENGINEER** is recognized in every country of the world as the leading electrical journal .. ..

SENSE & DOLLARS

You can save a dollar or more by buying other meters than the Gutmann. In the end you will save many times that, by installing Gutmann Alternating Current Integrating Wattmeters. Give them a trial—It's a proposition of sense and dollars.

Have we sent you our little booklet, "Skepticism"?

ELECTRIC APPLIANCE COMPANY, CHICAGO

General Electric Company's....

New Adjuster for X-Ray Tubes by means of which the proper degree of vacuum can be maintained for an indefinite period, insuring high efficiency and long life.

Send for Catalogue No. 9050.

EDISON DECORATIVE AND MINIATURE LAMP DEPARTMENT,

(1) HARRISON, N. J.

P & B INSULATION

P & B Electrical Compound
P & B Armature and Field Coil Varnish
P & B Insulating Tape
THE INSULATION THAT INSULATES
—and Insulates Lastingly

THE STANDARD PAINT CO., 83-85 JOHN ST. NEW YORK

National Electrical Code Standard

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." WEATHERPROOF,
SLOW BURNING WEATHERPROOF,
AND SLOW BURNING WIRE.

PRICES AND SAMPLES ON APPLICATION.

PHILLIPS INSULATED WIRE CO.,
OFFICE AND FACTORY, PAWTUCKET, R. I.

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

INDIA & AMBER **MICA** IN ANY SHAPE OR PATTERN. WRITE FOR SAMPLES.

FOR ARMATURE COILS AND FIELDS. **EMPIRE** INSULATED Cloths and Papers. **M·I·C·** COMPOUND UNEQUALED.

Eugene Munsell & Co. Mica Insulator Co. 218 Water St. New York & Chicago. 117 Lake St. Stansted, Essex, Eng.

PERFECT **MICANITE** INSULATOR REGISTERED. SEND FOR PRICES.

"HYLO"

(High-Low

Stands for a lamp which can be turned down; takes 10 watts when turned down; can be used with any shade; has other virtues. Electrical dealers should write for prices at once. *Real* dealers will not wait till the customer comes with a club.

THE PHELPS COMPANY,
10 Hawthorne Street, • Elmwood, Ill.

NAME PLATES

FOR MACHINERY.

We make name plates for some of the largest makers of machinery in the U. S. and we would be pleased to send you sample and quote price.

No Plate Too Large or Too Small.

MURDOCK PARLOR GRATE CO.,
157 Boylston St., Boston, Mass., U. S. A.

IN WRITING TO ADVERTISERS Subscribers will confer a favor on us and also on the advertisers by mentioning that they saw the advertisement in ELECTRICAL WORLD AND ENGINEER.

SAMSON SPOT CORD FOR...

Arc Light AND Trolley Cord.

Send for Samples and Prices.

SAMSON CORDAGE WORKS. BOSTON, MASS.

STERLING EXTRA INSULATING VARNISH.

Sterling Extra Black Finishing Varnish. Sterling Black Air Drying Varnish.

Sterling Black Core Plate Varnish

THE STERLING VARNISH CO.,
Times Building. PITTSBURGH, PA., U. S. A.

HAVE YOU TRIED LAVA?
Insulating Washers, Bushing, etc.
D. M. STEWARD MFG. CO.
New York Office: 107 Chambers St. Chattanooga, Tenn.

What is more easy than rolling off a log?

The laying of McRoy conduits—the multiple kind.

JOHN T. McROY
302 BROADWAY, NEW YORK
138 WASHINGTON ST., CHICAGO

THE "CLARK" WIRE.

For Switchboard, Railway and Motor use.

All sizes of stranded and flexible wire and cables with Clark's insulation.

Inspector Boston Fire Underwriters' Union says:—"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used—Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogue, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,

HENRY A. CLARK, Treas. and Gen'l Mgr.
HERBERT H. EUSTIS, Prest. and Electrician.

61-63 Hampshire Street,
BOSTON, MASS.

FRANK N. PHILLIPS, Pres. C. H. WAGENSEIL, Treas. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. R. REMINGTON, Jr., Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Bare and Insulated Electric Wire,
Electric Light Line Wire, Incandescent and Flexible Cords.
Railway Feeder and Trolley Wire,
Americanite, Magnet, Office and Annunciator Wires.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK: W. J. Watson, 26 Cortlandt St.
CHICAGO: F. E. Donohoe, 241 Madison St.
MONTREAL: Eugene F. Phillips' Electrical Works.
Main Office and Factories, Phillipsdale, R. I.

HENRY C. TOWNSEND
Formerly Principal Examiner Electrical Division U. S. Patent Office.
DELBERT H. DECKER
Late Assistant Examiner, Electrical Division U. S. Patent Office.
TOWNSEND & DECKER, Solicitors of U. S. and Foreign Patents.
141 Broadway, New York
Expert Opinions on the scope and validity of Patents

DYER, EDMONDS & DYER
..PATENTS..
31 Nassau Street,
NEW YORK CITY.

DO YOU WISH TO STUDY ELECTRICITY?
Write for our free illustrated book, entitled
"CAN I BECOME AN ELECTRICAL ENGINEER?"

I consider the Electrical Engineer Institute to be conducted by Messrs. Wetzler and Martin up to as good a point as it is possible to bring the Electrical education
Thomas A. Edison

The Electrical Engineer Institute of Correspondence Instruction Dept. H, 240-242 W. 23d St., New York
JOS. WETZLER, M. E., E. E., Pres.
T. COMMERFORD MARTIN, Vice-Pres.

THOMAS J. JOHNSTON
COUNSELLOR AT LAW
66 Broadway New York City
Six years with General Electric Company
Patent Causes Patent Soliciting

WM. A. ROSENBAUM
Electrical Expert and Patent Solicitor....
ROOM 177 TIMES BUILDING NEW YORK CITY

Electricity for Engineers—

Hawkins' Catechism of Electricity, a complete practical book on electrical engineering, easily understood. Sent postpaid to any address upon receipt of $2, money refunded if not satisfactory.

THEO. AUDEL & CO.,
63 FIFTH AVE., - - - NEW YORK.

EDWARD P. THOMPSON, M. E.
Registered Solicitor of Patents,
81 FULTON STREET, N. Y. CITY.

Successful practice by correspondence for fifteen years.
Manager POWER Patent Bureau for two years.
Manager ELECTRICAL WORLD Patent Agency for two years.
The only solicitor who is a member of both the Amer. So. Mech. Eng. and A. I. E. E.
Send for circular, references, estimates, etc.

"American" Storage Cells are the best.
....Send for descriptive circular....
Absolutely Non-infringing. Protection Guaranteed.
AMERICAN BATTERY CO.,
Est'd 1889. 172 S. Clinton St., Chicago, Ill.

SHEET METAL STAMPING
WINDING
EXPERIMENTAL WORK
MODEL MAKING
STANDARD STAMPING and DIE COMPANY
32d STREET and 4th AVENUE
BROOKLYN, N. Y. TEL. 451 SOUTH

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

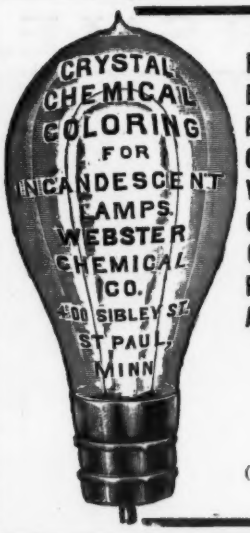
ELECTRIC ARC LIGHTING

BY
Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D.
(Electro-Technical Series.)

Cloth, 452 Pages, 147 Illustrations.
Price, $1.00

Copies of this or any other electrical book published will be sent by mail, postage prepaid, to any address in the world on receipt of price.

Electrical World and Engineer
PUBLISHERS
120 Liberty St., New York



Ruby Red
Blue
Pink
Ground Glass
Yellow
Opal White
Green
Purple
Amber

SEND FOR (2) CIRCULAR

JACOB STUCKY,

17-19 Alling Street, NEWARK, N. J.
L. D. Telephone, 3052.

Practical Electrical Machinist

Dynamos, Motors, Armature Winding, Commutators of any manufacture refilled. 24 years' experience managing the construction of Electrical Machinery.

WATERTIGHT ELECTRICAL FITTINGS

For Marine Construction Work

WATERTIGHT SWITCH

THE ELECTRO-DYNAMIC CO., Philadelphia, Pa., U. S.

NO ELECTRICAL JOURNAL published has so large a foreign and domestic circulation as Electrical World and Engineer.

POSITIONS WANTED.

The rate for "Position Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each. Remittance should accompany order.

POSITION WANTED—By man, engaged many years in incandescent lamp work; university education; experienced in every detail of lamp manufacture; squirted cellulose filament, 1-10 to 4 amperes; round, perfect, structureless cellulose filament, 2 to 10 amperes. Odd voltages practically nil. Address "CARBON," care Electrical World and Engineer, New York.

POSITION WANTED—Two engineers desire to form connection with parties having capital to invest in building telephone exchange from 100 lines up; one is college graduate with three years' experience on switchboard work; the other is practical in electrical work with eight years' experience with Bell and independent telephone echanges. Will take stock in company for services as engineers. Address "Z. AND X.," care Electrical World and Engineer, New York.

POSITION WANTED—As manager or superintendent of electric lighting plant; four years' experience as manager of light and power plant; married; best of references. Address "G. B. F.," care Electrical World and Engineer, New York.

WE PUBLISH AND SELL

BOOKS

On All Electrical Subjects

Write for Catalogue

Electrical World and Engineer

120 Liberty Street, New York

YOU NEED IT!

GALE'S COMMUTATOR COMPOUND.

Gale's Commutator Compound.

The Only Article that will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes. 50c. per stick. $5.00 per dozen. *Send 50c. for trial stick.*

FOR SALE BY ALL SUPPLY HOUSES, OR

K. McLENNAN & CO., SOLE MANUFACTURERS, 909, 100 Washington Street, CHICAGO.

IF YOU WANT AN ARTICLE THAT WILL POLISH QUICKLY, TRY

U.S. METAL POLISH

FOR POLISHING ALL KINDS OF METALS

Geo. W. Hoffman, 295 E. Washington St., Indianapolis, Ind.

HELP WANTED.

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each. Remittance should accompany order.

WANTED—Salesman to handle specialties in Chicago and vicinity; low pay to begin, with an opportunity for advancement; must have a promising record with some Chicago supply house. Address "A. B.," care Electrical World and Engineer, New York.

WANTED—A1 traveling salesman with established trade to sell enclosed arc lamps. Address, giving references, experience and salary desired, "ARC," care Electrical World and Engineer, New York.

WANTED—Competent and experienced salesman; must be thoroughly posted in the line of electric cranes, and preference will be given to one who is familiar with the trade in Pittsburg district. Address "Y. W. P.," care Electrical World and Engineer, New York.

WANTED—An electrician with mechanical and electrical experience and some capital to take superintendency of lighting plant in a hustling Southern city of 5000 and an interest in the business. State particulars. Address "S. Z. I.," care Electrical World and Engineer, New York.

WANTED—First-class armature winder, capable of taking charge of armature and field winding department of manufacturing establishment in the West; must be a thoroughly experienced and competent man of temperate habits, and reliable. A steady position for the right party. Married man preferred. State age and experience and give references. Address "MOTOR," care Electrical World and Engineer, New York.

WANTED—Technical graduate who has had practical experience in designing and estimating switchboards and panel boards. Address, giving references, experience and salary expected, "F. S.," care Electrical World and Engineer, New York.

WANTED—Competent armature winders. Apply E. A. STARKS, West Point Foundry, Cold-Spring-on-Hudson, N. Y.

WANTED—Master mechanic to take charge of an electric railway car shop; must understand the electrical part and be a thorough machinist. Address "FALLS," care Electrical World and Engineer, New York.

WANTED—An experienced shipping clerk in an electrical jobbing house; one who knows his business; state reference, experience, age, etc. Address "F.," care Electrical World and Engineer, New York.

WANTED.

First-class incandescent electric lamp factory in Europe wants first-class technical manager. Specially wanted great experience in high voltage lamps. Offers under. Discretion guaranteed. Address "B. D.," 1972, care Haasenstein & Vogler, in Berlin, Germany.

A GOOD CHANCE FOR RIGHT MAN.

A man wanted to take charge, as general manager, of a plant which is exclusively devoted to the manufacturing of Arc Lamps of all types. (Has no debts.)

Must come highly recommended and best of references exchanged; must be able to take stock in company to assure faithful services. State experience, where employed, etc. Address "CENTURY," Care Electrical World and Engineer, New York City, N. Y.

BOSTON ENGINEERING AGENCY

Tremont Temple Bldg., Boston.

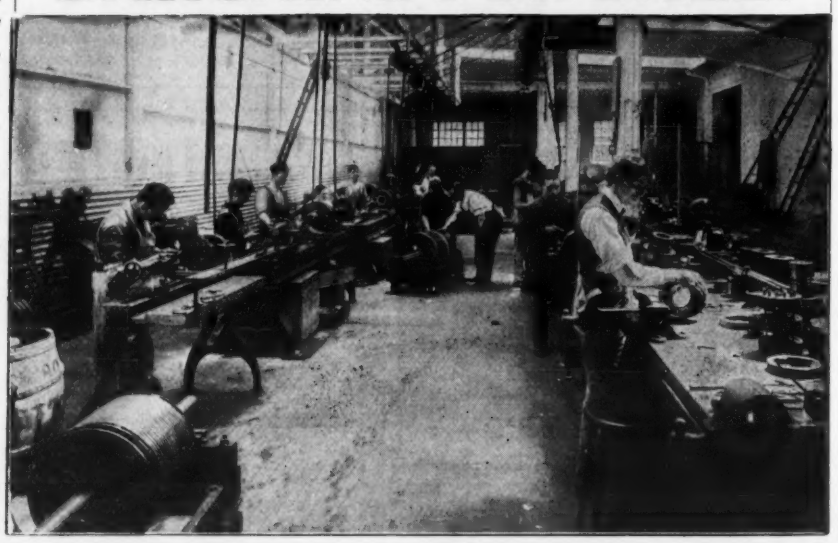
Positions Furnished

For Engineers of all kinds. Employers write us when they want assistance.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

BARGAINS FOR SALE.



VIEW MACHINISTS' DEPT., GREGORY ELECTRIC CO.

An immense stock of SWITCHES, RHEOSTATS, STARTING BOXES and SUPPLIES all at bargain prices.

FULL INFORMATION about any of this apparatus furnished cheerfully on request.

Send for our MONTHLY BARGAIN SHEET with complete list in stock and lowest net cash prices.

ALTERNATING GENERATORS.

1	350-light		Thomson-Houston, A18.
2	600	"	T.-H., A6.
1	600	"	T.-H., 30 K.W., 2-phase.
1	600	"	T.-H., 30 K.W., slotted armature, compound.
2	600	"	G. E., A30, toothed armature, compound wound.
2	650	"	T.-H., A35, self-oilers, composite wound.
2	750	"	Westinghouse, s. o., 37½ K.W.
1	1200	"	T.-H., 60 K.W., comp. wound, self-oiler, toothed armature.
1	1200	"	Warren, 60 K.W., self-oiler, inductor type.
1	1200	"	G. E., A60, composite wound, toothed armature, self-oiler.
2	1300	"	T.-H., A70, self-oilers, compound wound.
1	1500	"	Wood, 75 K.W., s. o., compound wound, toothed arm't.
1	1500	"	G. E., monocyclic, 75 K.W., s. o., 60-cycle, 7200 alt., 1100 volts, practically new.
1	1800	"	National, 90 K.W., toothed armature.
2	2400	"	Gen. Elec., A120.
1	4000	"	Wood, 200 K.W., s. o., compound wound, slotted arm't.

ARC DYNAMOS.

1	20-light	2000	C.P.	Western Electric.
1	30	1200	"	T.-H., K12.
1	30	2000	"	Brush, No. 7.
2	35	2000	"	T.-H., L.D. 2.
1	35	1200	"	Wood, No. 6.
3	40	2000	"	West. Electric, s. o.
2	45	1200	"	T.-H., M12, ball armt.
2	45	1200	"	Brush, No. 7.
1	50	1200	"	T.-H., L.D. 12, ball armature.
1	50	2000	"	T.-H., M.D. 2, ring armature.
1	50	2000	"	Brush, No. 7½.
2	60	2000	"	West. Elec., s. o.
1	60	2000	"	Westinghouse.
3	60	2000	"	Wood, No. 8.
1	65	800	"	Ball, 4 amp.
1	65	2000	"	Brush, No. 8, Steubenrausch fireproof commutator.
2	75	1200	"	Wood, with new armt.
2	75	1200	"	Standard, self-oilers.
2	75	2000	"	Westinghouse, s. o.
3	125	1200	"	Excelsior, latest type.

110-VOLT MOTORS.

2	1	H.P.	Edison, s. o., ¾ K.W.
1	3	"	Westinghouse, vertical.
1	3	"	Card, M.P., s. s., self-oiler.
4	3	"	Gibbs, M.P., self-oilers, slow speed, brand new.
1	4	"	Siemens & Halske, M.P., type B, s. o., brand new.
1	4	"	Gibbs, M.P., s. o., moderate speed, brand new.
3	4	"	Gibbs, M.P., s. o., s. s., brand new.
1	5	"	Siemens & Halske, s. o., bipolar, brand new.
	5	"	Siemens & Halske, M.P., ironclad type, s. o., brand new.
1	6	"	Gibbs, M.P., self-oiler, slow speed, brand new.
1	7½	"	Bain, self-oiler.
1	7½	"	J. & C., self-oiler.
2	7½	"	Gibbs, M.P., self-oilers, slow speed, brand new.
2	7½	"	Siemens & Halske, M.P., Churchward type, s. s., 650 r. p. m., brand new.
1	10	"	Card, self-oiler.
3	10	"	Gibbs, M.P., self-oilers, moderate speed, brand new.
2	10	"	Gibbs, M.P., self-oilers, slow speed, brand new.
2	12	"	Siemens & Halske, M.P., ironclad, brand new.
2	15	"	Edison, 12 K.W., self-oilers.
4	15	"	Siemens & Halske, self-oilers.
3	15	"	Gibbs, M.P., self-oilers, slow speed, brand new.
3	15	"	Siemens & Halske, M.P., type B, self-oilers, brand new.
1	18	"	Westinghouse, horiz. type.
1	18	"	Eddy, self-oiler.
1	18	"	Commercial, self-oiler.
2	20	"	Westinghouse, M.P., s. s.
1	20	"	Columbian, M.P., s. o., s. s.
2	20	"	Gibbs, M.P., self-oilers, slow speed, brand new.
1	24	"	Eddy, self-oiler.
2	25	"	Hawkeye.
1	25	"	Edison, 20 K.W., self-oiler.
1	25	"	Duplex, M.P., self-oiler, s. s.
1	25	"	National, self-oiler.
1	25	"	Western Electric.
8	25	"	Siemens & Halske, self-oilers.
6	35	"	Edison, 30 K.W., self-oilers.
9	35	"	Siemens & Halske, s. o.
1	40	"	Eickmeyer.
2	50	"	Westinghouse, 10-pole, s. s., 40 K.W., s. o., brand new.
3	60	"	Edison, 45 K.W., self-oilers.
1	90	"	Siemens & Halske, self-oiler, 70 K.W.

IMMEDIATE DELIVERY

DIRECT CONNECTED UNITS.

110 VOLTS.

2 100-kw Westinghouse, 8-pole, 225 r. p. m., direct-connected to McIntosh & Seymour comp. engines.

BELTED RAILWAY UNITS.

5-200 k-w Edison-self-oiling 500 Volt Generators belted to 18 1-2" x 18" Center Crank High Speed Auto Engines.

BELTED DYNAMOS AND MOTORS.
110 VOLTS.

2 150-kw Edison Bipolar.
4 60-kw " "
2 45-kw " "
3 30-kw " "
4 25-kw " "
2 20-kw " "
2 15-kw " "
2 10-kw " "
1 100-kw M.P. Westinghouse.
2 45-kw comp. Westinghouse, M.P., 4.
2 60-hp M.P. Westinghouse.
1 500-ampere Onondaga.
1 25-kw Electro Dynamic.
1 45-kw General Electric, M.P., 850 r. p. m.

BELTED DYNAMOS AND MOTORS.
220 VOLTS.

1 75-kw Siemens-Halske.
1 15-hp Excelsior.
1 10-hp Eddy, bipolar.
1 5-hp Eddy, bipolar.
1 30-kw M.P., General Electric.

RAILWAY GENERATORS.
BELTED.

1 500-kw M.P., 4, Gen. Electric.
1 300-kw M.P., 4, Gen. Electric.
1 200-kw M.P., 4, Walker.
1 111-kw M.P., 4, Westinghouse.
1 100-kw M.P., 4, Gen. Electric.
1 100-kw B.P., Fort Wayne.
5 200-kw Edison.

DIRECT CURRENT.
500 VOLTS.

2 60-kw Edison.
2 50-hp M.P., General Electric, type H.
1 10-hp Eddy.
1 2-hp Cent. Elect. Co.

ARC DYNAMOS.

2 125-light, multi-circuit Brush, 2000-cp.
2 165-light, multi-circuit Brush, 1200-cp.
2 125-light, latest type Fort Wayne, 2000-cp.
2 125-light, brand new Excelsior, 2000-cp.
2 80-light, single circuit Brush, 2000-cp.
4 No. 8, 65-light, 2000-cp, Brush.

ALTERNATORS.

1 325-kw Siemens & Halske, 2000 volts, 7200 alternations, single phase.
1 300-kw Fort Wayne, 2000 volts, 7200 alternations, single phase.
1 240-kw Stanley, two-phase, 380 r. p. m., with engines direct-connected.
1 240-kw Westinghouse, 110 volts, 16,000 alternations, single phase.
1 150-kw Westinghouse, two-phase, 1100 volts, 600 r. p. m., 7200 alternations.
2 A-120 General Electric, single phase, 1000 volts, 16,000 alternations.
2 90-kw Gen. Elec., single phase, 1000 volts, 16,000 alternations.
2 120 Westinghouse, single phase, 1100 volts, 16,000 alternations.
1 110-kw Fort Wayne, 2200 volts, 16,000 alternations.
1 60-kw General Electric, single phase, 2000 volts, 16,000 alternations.
1 60-kw Stanley, two-phase, 2000-1000 volts, 7200 alternations.
1 75-kw Stanley, 2000-1000 volts, two-phase, 16,000 alternations.
1 200-hp Westinghouse motor, two-phase, 3000 alternations, 400 volts, shaft 4⅞ inch diameter, pulley 25-inch face, 30-inch diameter.
1 45-kw Westinghouse, 2200 volts, 16,000 alternations.
1 45-kw Westinghouse, 1100 volts, 7200 alternations.

STREET CARS.

Open and closed, of all sizes, and for all gauges. *Let us know your wants.*

RAILWAY MOTORS.

G. E. 800, S. R. G., 30.
G. E. 1000, W.P., 30.
G. E. 1200, W.P., 50.
Westinghouse, 3.
Westinghouse, 12A.
Westinghouse, 38B.
K, K2 and K12 G. E. Controllers.
Westinghouse 38 and 49 Controllers, and a constantly changing stock of everything pertaining to street car equipment.

ENGINES.

24 in. x 48 in. Wetherell.
18 in. x 42 in. Allis.
16 in. x 42 in. Hamilton.
18½ in. x 18 McIntosh & Seymour.
16 x 16 Erie Ball.
16 in. x 16 in. Cooper Auto.
14 x 13 Armington & Sims.
13 in. x 14 in. Watertown.
13 in. x 12 in. N. Y. Safety.
10 in. x 12 in. Watertown.
16½ x 25 x 15 Armington & Sims Cross Compound.
5 18½ x 18 in. Ideal.

BOILERS.

2 375-hp Sterling boilers, 150 lbs. pres.
2 175-hp Sterling boilers.
2 200-hp National water tube.
Boilers of various styles and sizes at low rates.

Street Railway and Lighting Machinery of Every Description.

ROSSITER, MAC GOVERN & CO.

Principal Offices, 141 BROADWAY, N. Y. *Factory,* BROOKLYN, N. Y.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO.

Large stock of Meters, Arc Lamps, Station Instruments and Supplies. All apparatus fully guaranteed in perfect operative condition. Send for Monthly Bargain Sheet with complete list and net prices.

2 125 H.P. Siemens & Halske, self-oilers, 100 K.W.

220-VOLT MOTORS.

1 ¼ H.P. Lundell, for direct connection linotype machine, very slow speed.
1 1 " E. & C., new, s. o., M.P., s. s.
1 2 " Belding.
1 2 " Thomson-Houston.
1 2 " Lundell, self-oiler, s. s.
3 3 " Sprague, self-oilers.
1 3 " Crocker-Wheeler, s. o., s. s.
1 3 " G. E., type I B, self-oiler.
3 3 " Card, slow speed, self-oilers.
1 5 " Eddy, ring type, self-oiler.
1 5 " Westinghouse, self-oiler.
1 5 " C & C.
1 5 " Akron, self-oiler.
25 5 " Gibbs, M.P., self-oilers.
3 5 " Westinghouse, s. o., M.P., slow speed.
1 7½ " Eddy, self-oiler.
1 7½ " Edison, 6 K.W., self-oilers.
1 10 " Eddy. s. o., new armature.
1 10 " Eickmeyer, elevator motor, with controller.
1 10 " Lundell, self-oiler.
1 10 " Westinghouse, M.P., s. o.
1 12 " Lundell, 10 K.W., M.P., s. o., slow speed.
1 15 " Eddy, s. o., new armature.
1 15 " Edison, self-oiler, 12 K.W.
1 15 " Mather, ring type, new arm't.
1 18 " Edison, self-oiler, 15 K.W.
1 20 " Sprague.
1 25 " Sprague.
1 35 " Siemens & Halske, M.P., self-oiler, ironclad, brand new.
1 50 " Northern, M.P., s. o., new.
1 60 " Edison, self-oiler.

500-VOLT MOTORS.

1 1 H.P. Holtzer-Cabot, self-oiler, s. s.
1 1 " Crocker-Wheeler, s. o., s. s.
1 2½ " Holtzer-Cabot, self-oiler.
1 5 " Westinghouse, M.P., self-oiler.
1 7½ " Eddy, type C, self-oiler, new armature.
1 7½ " Siemens & Halske, M.P., Churchward type, brand new, slow speed.
1 10 " C & C.
1 10 " Commercial, self-oiler.
1 10 " Card, M.P., self-oiler, s. s.
1 10 " Eddy, M.P., self-oiler, s. s.
1 10 " Westinghouse, M.P., self-oiler.
1 15 " Siemens & Halske, M.P., Churchward type, brand new, slow speed.

1 18 H.P. Thomson-Houston, self-oiler.
2 18 " Edison, 15 K.W., self-oilers.
2 18 " C & C, self-oilers.
1 20 " Commercial, self-oiler.
1 20 " Card, self-oiler.
1 40 " Mather, self-oiler.
2 40 " Siemens & Halske, M.P., Churchward type, brand new, s. s., 425 r. p. m.
1 60 " Edison, 45 K.W., self-oiler.

110-VOLT INCANDESCENT DYNAMOS.

2 12-light Edison, ¼ K.W., self-oilers.
4 35 " Gibbs, M.P. slow speed, compound, brand new.
1 50 " Hawkeye.
1 50 " Nowotny, self-oiler.
1 50 " Card, M.P., self-oiler, slow speed, 1150 r. p. m.
1 50 " Crocker-Wheeler, s. s., s. o.
2 55 " Gibbs, M. P., compound, brand new, moderate speed.
4 55 " Gibbs, M.P., compound, brand new, s. s., 1100 r.p.m.
1 55 " Siemens & Halske, type B, M. P., s. s., s. o., brand new.
1 60 " Thomson-Houston.
1 60 " Westinghouse.
1 80 " Siemens & Halske, type L.H., self-oiler, brand new.
2 80 " Siemens & Halske, ironclad type, M.P., s. o., brand new.
1 100 " Bain, compound, self-oiler.
1 100 " J. & C., self-oiler.
4 110-light Gibbs, M.P., compound, s. o., brand new, s. s., 1100 r. p. m.
1 110 " Siemens & Halske, M.P., Churchward type, compound, extra slow speed, brand new, 650 r. p. m.
3 150 " Gibbs, M.P., compound, self-oilers, speed 1650.
1 150 " Gibbs, M.P., shunt, self-oiler, slow speed, 825 r. p. m.
1 160 " Card, self-oiler.
2 180 " Siemens & Halske, M.P., self-oilers, brand new.
2 210 " Edison, self-oilers, 12 K.W.
4 210 " Siemens & Halske, 12 K.W.
4 210 " Gibbs, M.P., self-oilers, very slow speed, 725 r. p. m., brand new.
1 250 " Westinghouse, horiz. type.
1 250 " Commercial, comp., self-oiler.
1 250 " Eddy, self-oiler.
1 270 " G. E., 15 K.W., M.P., direct connected to Case engine, compound.
2 270 " Westinghouse, M.P., slow speed, 15 K.W.
1 300 " Columbian, M.P., comp., self-oiler, s. s.
4 300 " Gibbs, M.P., s. o., s. s., 725 r. p. m., brand new.
1 340 " Eddy, self-oiler, compound.
2 350 " Hawkeye, comp.
1 350 " National, s. o., compound.
1 350 " Edison, 20 K.W., self-oilers.
1 350-light Western Electric,
6 350 " Siemens & Halske, self-oilers.
1 360 " Duplex, M.P., self-oiler, compound, slow speed.
12 500 " Siemens & Halske, self-oiler.
4 540 " Edison, 30 K. W., self-oilers, compound.
1 600 " Eickmeyer.
2 700 " Westinghouse, 10-pole, s. s., 40 K.W., self-oilers, 575 r. p. m., brand new.
1 800 " Edison, 45 K.W., s. o., comp.
1 1200 " Siemens & Halske, type L.H., 70 K.W., self-oiler.
1 1350 " Siemens & Halske, type I., 80 K.W., for direct connection, 8-pole.
2 1500 " Siemens & Halske, type L.H., self-oilers, 100 K.W.
1 1500 " Siemens & Halske, 100 K.W., type I., 6-pole, for direct connection, brand new.

220-VOLT GENERATORS.

1 8½ K.W. Westinghouse, M.P., s. o.
1 9 " Lundell, self-oiler.
1 10 " Lundell, s. o., M.P., s. s.
1 12 " Edison, self-oiler.
1 15 " Edison, compound, s. o.
1 30 " Siemens & Halske, M.P., ironclad type, s. o., brand new.
1 45 " Edison, compound, self-oiler, new armature.
1 50 " Siemens & Halske, M.P., Churchward type, s. o., brand new, for direct connection.
1 marble panel switchboard for above.
1 100 " Siemens & Halske, M.P., Churchward type, s. o., brand new, for direct connection.

500-VOLT GENERATORS.

2 15 K.W. Edison, self-oilers.
1 15 " T.-H., self-oiler.
1 35 " Mather, self-oiler.
2 35 " Siemens & Halske, brand new, M.P., Churchward type, s. o., very slow speed, 475 r. p. m.
1 45 " Edison, compound, self-oiler.
1 75 " Westinghouse, Kodak set, Westinghouse generator and Westinghouse comp. engine 14x24x14, all complete, fine.

DYNAMOS = MONEY SAVERS! = ENGINES

ARC LIGHT GENERATORS.

1—K30 light, 1200-cp, T.H.
1—L25 light, 2000-cp, T.H.
4—M45 light, 1200-cp, T.H.
6—L.D. 12, 50 light, 1200-cp, T.H.
10—M.D. 2, 50 light, 2000-cp, T.H.

ALTERNATORS.

1—300 K.W. General Electric Inductor, 6600 volts.
1—400 " General Electric, 6600 volts.
1— 60 " Stanley Inductor, 1000 x 2000 volts.
1— 60 " Westinghouse, 2000 volts.
1—240 " General Electric, 1140 volts.
2—A60 T.H., 2280 volts.
2—A60 T.H., 1100 volts.
2—A30 T.H., 1100 volts.
2—A70 T.H., 1100 volts.
1—A75 T.H., 1100 volts.
1— 30 K.W. National, 1100 volts.
1— 30 " Westinghouse, 1100 volts.
1—100 " Westinghouse, 220 volts.

ALTERNATING-CURRENT MOTORS.

1— 5 H.P. Fort Wayne, 125 cycles, single-phase.
1—10 " Excelsior, 60 cycles, single-phase.
2—50 " Westinghouse, type C, 220 volts.

110-VOLT DYNAMOS.

1— 5 K.W. Eddy direct connected to Case engine.
1— 25 K.W. Eddy direct connected to Russel engine.
4— 15 " Edison bipolar.
3— 20 " "
2— 25 " "
4— 30 " "
2— 45 " "
1—D50 " T.H.
1— 50 " Card M.P.

500-VOLT GENERATORS AND MOTORS.

1—500 K.W. General Electric.
2—100 " Edison bipolar.
1—150 " Walker.
1— 45 " Fort Wayne, Wood.
2— 75 " M.P. T.H.
1— 90 K.W. M.P. T.H.
2—D62 TH.
1—D40 T.H.

ENGINES.

1—1600 H.P. Green-Wheelock, new.
1—1000 H.P. Fraser Chalmers.
1—9½ Armington & Sims.
1—13x13 Armington & Sims.
1—12x12 Armington & Sims.
1— 75 H.P. Westinghouse, Jr.
3— 60 " Westinghouse standard.
1—250 " Westinghouse compound.
2—150 " Westinghouse compound.
1—175 " Dick & Church.
1—250 " Lake Erie Engineering Co.
1—300 " Dick & Church.

Full line of arc lamps, series and incandescent arc.
Correspond with us to buy or sell anything in the electrical line. Write for anything wanted for use in Electric Railways, Electric Light and Power plants.

THOMPSON SON & CO., 107 LIBERTY STREET, N.Y.

BARGAINS IN SECOND-HAND ELECTRICAL MACHINERY.

DYNAMOS—110 VOLTS.

1— 12-light Elbridge, s. o., new.
1— 100-light Daft.
1— 250-light U. S.
1— 350-light Davis.
1— 800-light G. E.
1—1800-light Fort Wayne, 6-pole.

ARC DYNAMOS.

1 Brush, 1 light, 3000-cp.
1 Brush, 3 light, 2000-cp.
2 American Wood, 20 lights, 2000-cp.
1 Western Electric, 30 lights, 2000-cp.
1 T.-H., L. D.-2, 35 lights, 2000-cp.
1 Wood No. 6, 35 lights, 1200-cp.

GENERATORS.

1 U. S., 15-kw, 110 volts.
1 Davis, 22-kw, s. o., 110 volts.
1 Ft. Wayne, 6-pole, 100-kw, 110 volts, new.
1 Edison, 12-kw, s. o., 220 volts.
1 Wood B. P., compound, 45-kw, s. o., 500 volts.
1 T.-H., M.P.,—75, 75-kw, s. o., 500 volts.
1 Edison No. 32, 100-kw, s. o., 500 volts.

ALTERNATING GENERATORS.

1—3A Slattery, 1300 lights, 16,000 alternations, 1100 or 2200 volts, s. o., with exciter.
1—A60 G. E., 1200 lights, 15,000 alternations, 1100 or 2200 volts, s. o., with exciter.

REPAIRS
LONG DISTANCE TELEPHONE No. 1117
STEWART ELECTRICAL CO.
S.E. COR. FIFTH & SYCAMORE. CINCINNATI, O.
E.W. McGLINN
SOLE PROPRIETOR

ARC LAMPS, ARMATURES, TRANSFORMERS, INSTRUMENTS, SWITCHES.
A Large Assorted Stock.

MOTORS—110 VOLTS.

⅛-hp Diehl, s. o.
¼-hp Edison.
¼-hp Elbridge, s. o.
1-hp Sprague.
1-hp Card.
3-hp Nowotny.
10-hp Daft.
20-hp U. S.
28-hp Queen City, s. o.

MOTORS—220 VOLTS.

1-hp Nowotny.
5-hp Davis.
10-hp E. R. & C. C., s. o.
10-hp Daft, 800 r. p. m.
15-hp Edison, s. o.

MOTORS—500 VOLTS.

20-hp Davis, s. o.
25-hp Brush, 350 r. p. m.
60-hp Wood, B. P., s. o.
90-hp T.-H., M.P., s. o.
120-hp Edison, B. P., s. o.

STEWART ELECTRICAL CO., S. E. Cor. Fifth and Sycamore, CINCINNATI, O.

SECOND EDITION.

ALTERNATING-CURRENT

WIRING AND DISTRIBUTION

BY WILLIAM LEROY EMMETT.

98 Pages, 33 Illustrations. Price, $1.00.

The object of this work is to point out the practical significance of some of the laws governing the distribution of alternating currents, and to explain these laws in such a manner that their nature and relative importance may be realized by practical men without the expenditure of time necessary to the study of a complete work on the subject.

Copies of this or any other electrical book published will be sent by mail, postage prepaid, to any address in the world, on receipt of price.

ELECTRICAL WORLD & ENGINEER,
PUBLISHERS,
120 LIBERTY STREET, NEW YORK.

BARGAINS IN ELECTRICAL MACHINES.

1 150 K. W. Westinghouse Alternating Dynamo, 16000 alternations, 125 cycles, 1000 volts, complete with exciter, volt and amp. meter, and main switch.
1 150 K. W. General Electric Alternating Dynamo, 16000 alternations, 125 cycles, 1000 volts, complete with exciter, volt and amp. meter, and main switch.
1 80 K. W. C. & C. Dynamo, compound wound, 650 rev.
1 80 K. W. T. & H. Dynamo, 220 volts, speed 1020, compound wound.
1 30 K. W Slattery Alternator, single phase, with exciter and instruments.
1 65 K. W. Slattery Alternator Dynamo, single phase, with exciter and instruments.
1 60 K. W. Slattery Alternator, single phase, with exciter and instruments.
1 25 K. W. C. & C. Dynamo, 110 volts, 925 rev., compound wound.
2 16 K. W. C. & C. Dynamos, serial wound, 220 volts.
1 600 light Mather Dynamo, 115 volts, 900 rev.
3 500 light, 110 volt Edison Dynamos.
1 100 light, 110 volt Edison Dynamo.
1 50 light Technic Dynamo, 110 volts.
2 40 light Wood Arc Dynamos.
1 15 H. P., 220 volt T. & H. Motor.
1 10 H. P. 500 volt Central Elec. Co. Motor
1 10 H. P. 500 volt Ferret Motor.
1 3 K. W. Edison Dynamo, 110 volts.

Large stock of Dynamos and Motors of all makes, also large stock of high speed Automatic Engines, Corliss, etc., and Boilers, and General Machinery.

Local and L. D. Telephone 261 and 262. FRANK TOOMEY, 127-131 N. Third Street, Phila.

FOR SALE.

An electric light plant located in a growing county seat of 6000 people in Northern Wisconsin; Corliss engine, alternating system, business paying a dividend of $600 per month and is growing all the time. Address

RHINELANDER LIGHTING CO.
RHINELANDER, WIS.

WANTED.

One second-hand 600 to 700 horse-power cross compound high-grade heavy duty Corliss engine in first-class condition. Address, with full description and price and date of delivery, F. W. LITTLE, Peoria, Ill.

The men with whom you wish to do business are readers of ELECTRICAL WORLD AND ENGINEER.

Cream Flux

An Absolutely Non-Corrosive Insulating Soldering Flux FOR ALL METALS. Contains no Acid or Any Element Injurious to Electrical Connections. **We Guarantee it, and if not Satisfactory, Money will be Refunded.** You can make more than double the number of perfect connections in one half the time with CREAM FLUX than you can with the same amount of any other flux.

PUT UP IN CANS AT 15c, 25c, 45c, and 75c

SEND FOR TRIAL BOX SPECIAL PRICES IN QUANTITY

THIS IS WHAT ONE USER HAS TO SAY: "After having tried the various soldering salts on the market, and after giving your **CREAM FLUX** severe tests on heavy cable connections, and on the finest stranded flexible drop cord work, we can safely say it meets all claims you make for it. I consider it one of the best ever offered for sale. Yours truly, CHICAGO EDISON CO.,
Per J. H. GOEAST, Constr. Supt."

Endorsed by the National Board of Fire Underwriters and all users

FOR SALE BY ALL SUPPLY HOUSES OR

CREAM FLUX CO., Sole Manufacturers, 100 Washington St., **CHICAGO**

American Street Railway Investments

Published • Annually

This annual publication gives a most complete presentation of the financial status of the city, suburban and interurban street railways of the United States. It contains a description of over 900 operating companies, including a history from date of organization; a statement of the capital stock and funded debt; statistics of operation for several years past in tabular form; details of equipment, including mention of types of apparatus; maps of the larger systems; names of officers; population of cities served. The "Red Book" is the standard authority in the electric railway field, and is of special value to street railway officials wishing to compare their receipts and expenses with those of other companies, to bankers and brokers dealing in investment securities, and to manufacturers, contractors, etc., containing, as it does, the completest possible statistics of every street railway in the United States. Cloth. Size of page 13 x 9½ inches. . . . . ***Price, $5.00***

Copies of this or any other electrical book published will be sent by mail, postage prepaid, to any address in the world, on receipt of price. .....

Electrical World and Engineer
120 Liberty Street, New York

You can reach everyone in the electrical field whose attention it is possible to secure through a newspaper by advertising in ELECTRICAL WORLD AND ENGINEER.

NOTICE

THE FOLLOWING — which we are offering at VERY ATTRACTIVE PRICES. IMMEDIATE DELIVERY.

DIRECT CONNECTED UNITS.

THREE 100 kw. Latest Type *Westinghouse* 125 Volt M. P. 8 Generators, with Tandem Compound *McIntosh-Seymour* High Speed Automatic Engines.

ARC DYNAMOS.

TWO No. 12. *Brush* Multi Circuit-165-1200 C. P. Lights.
TWO No. 11. *Brush* Multi Circuit-125-2000 C. P. Lights.
ONE No. 11. *Brush* Single Circuit-125-2000 C. P. Lights.
TWO No. 9. *Brush* Single Circuit 80-2000 C. P. Lights.
Two 125 Light. *Ft. Wayne* 2000 C. P.

RAILWAY UNITS.

FIVE *200 kw. Edison* Bipolar-compound-ring-oiling dynamos. Belted to 18 1-2 in. x 18 in. IDEAL center crank automatic engines. Will sell together or separately.

Write for Quotations.

ROSSITER, MAC GOVERN & CO.
141 BROADWAY, N. Y. CITY. *Factory*, BROOKLYN, N. Y.

FOR SALE.

500-light, 125-volt latest type multipolar generator, carbon brushes, compound wound, ironclad bar wound armature. Great bargain.

RUSHMORE DYNAMO WORKS,
JERSEY CITY, N. J.

COLORADO, UTAH, ARIZONA AND NEW MEXICO.

Contain marvelous scenery, great varieties of climate and wonders that all should see. The way to reach them is by the

NEW YORK CENTRAL LINES.

Copy of the Illustrated Catalogue of the "Four-Track Series," New York Central's books of travel and education, will be sent free, postpaid, to any address on receipt of a postage stamp, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

SECOND-HAND
DYNAMOS, MOTORS AND ARC LAMPS BOUGHT, SOLD AND EXCHANGED

Over 100 Dynamos in stock. Most complete repair shop in the West. Write us if you wish to buy or sell.

900 125-hour, 110-volt Siemens & Halske enclosed arc lamps, entirely new, price $8.50 each.

GUARANTEE ELECTRIC CO., 133-139 So. CLINTON ST., CHICAGO, ILL.
CHAS. E. GREGORY, Pres.

CHICAGO EDISON COMPANY
REPAIR SHOPS.
78 MARKET STREET, CHICAGO. TELEPHONE, MAIN 1280.
First-Class Equipment in all Shops.
OPEN DAY AND NIGHT. PROMPT ATTENTION.
Dynamos, Armatures, Motors, Arc Lamps, Instruments, Machine Shop; Engines, Etc., Carpenter Shops; Cabinets, Etc.
Correspondence Solicited.

SECOND-HAND
Dynamos and Motors.
WE INVITE CORRESPONDENCE WITH THOSE WISHING TO BUY OR SELL.
SCHUREMAN & HAYDEN,
137 S. Clinton St., Chicago.

We offer for IMMEDIATE SHIPMENT:

2—100 K.W., 500-volt Edison bipolars.
1— 75 " General Electric, 500 volts, 4-pole.
1—120 " A. S. type, General Electric Alternator.
3—120 " A. type, General Electric Alternator.
1—240 " Stanley, two-phase, 1000 or 2000 volts.
1— 50 " 2000-volt Siemens & Halske, 60-cycle.
1— 65-light Brush Arc, 10 amperes.
1— 40 " Western Electric Brush Arc.
1—600 H.P. Ball Cross Compound Engine, 20 x 36 x 18.
1—200 " Ball, 12 x 22 x 16, Tandem Compound, with Condenser.
1—175 " Ideal, 12 x 20 x 14, Tandem Compound.
2— 18½ x 18 Ideal.
1— 14½ x 15 McIntosh & Seymour.

BOILERS. MOTORS. PUMPS.
Write for our latest price list, No. 42.
Illinois Maintenance Company,
E. H. CHENEY, Manager,
204 Dearborn St., Chicago.

A GOOD OPENING

If you are LOOKING for a Snap here it is.

Franchise in live county seat East of Mississippi River, North of Ohio River, for Water and Electric Lights, City contract insures $5,500.00 and domestic consumers should be $6,000. Estimated Cost of Plant combined $28,000.00. For particulars write

"BONDS,"
Care of Electrical World and Engineer, New York.

An intending purchaser of electrical apparatus anywhere always consults this paper's advertising pages to ascertain who makes what he wants. ELECTRICAL WORLD AND ENGINEER is recognized in every country of the world as the leading electrical journal.

TRADE MARK
TESTED FUSE WIRE AND FUSE LINKS
STANDARD FOR ACCURACY

In the manufacture of fuses there are two essentials: 1st, ACCURACY; 2d, UNIFORMITY. The steady increase in our business during the past twelve years is the best evidence that our goods meet all requirements. All kinds of telephone fuses and bases well made and at low prices.

CHICAGO FUSE WIRE & MFG. CO.
58-64 N. Jefferson St., Chicago. 369 Broadway, New York.

When writing to advertisers please mention
ELECTRICAL WORLD
AND
ENGINEER.

FOR SALE

Journal London Institute Electrical Engineers from 1879 to date.

American Institute Electrical Engineers from beginning to date.

MAXWELL GORDON,
Faraday's Researches,
P. O. Box 8, Noroton, Conn.

FOR SALE.

10 H. P. 220 volt Detroit Motor.
2 H. P. Baxter Arc.
½ H. P. Baxter Arc; second hand, in good condition.

MICHIGAN ELECTRIC CO.
101 Woodward Ave., Detroit, Mich.

ELECTRICIANS

Wanted to send 25 cents in stamps or coin and get complete set of blue prints showing how to wire a motor car for two or four motors.

M. F. HANSON,
1558 N. Talman Ave., Chicago, Ill,

SALES

are quickly made by a small advertisement in these columns. Try it.

ELECTRICAL WORLD AND ENGINEER,
120 Liberty St., New York.

FOR SALE

QUICK DELIVERY. GOOD CONDITION. LOW PRICES.

ALTERNATORS.
1—120-kw Westinghouse.
1—120-kw G. E.
1—100-kw Wood.
2—70-kw T. H.
2—60-kw G. E.
2—60-kw Westinghouse.
1—50-kw Wood.
1—50-kw Westinghouse.
1—45-kw Westinghouse.
1—35-kw T. H.
3—30-kw G. E.
1—30-kw Westinghouse.

ARC DYNAMOS.
1—60 - light, 2000 - cp Wood, S.O.B. $300.
3—30 - light, 2000 - cp, Wood. $200 each.
2—45-light, 1200-cp, No. 7 Brush. $200 each.
2—35-light, 2000-cp, T. H., ring armature. $200 each.
1—30-light, 2000-cp, T.H., ring armature. $175.
2—160-light, 1200-cp. No. 12, Brush, multi-current, nearly new.

ENGINES.
1—150-hp Rollins Corliss.
2—150-hp A. & S.
1—150-hp Russell.
1—150-hp Ball.
1—125-hp Ball.
1—100-hp Ball.
1—100-hp Payne.
1—65-hp N. Y. Safety.
1—50-hp N. Y. Safety.
1—45-hp A. & S.
1—8-hp N. Y. Safety.

Write us about Alternators, Dynamos, Motors, Engines, etc., to buy or sell.

MAYO & ROHRER CO.

220 Broadway New York

SCRAP COPPER WIRE WANTED.

It will pay the electric plants, electric street railways and manufacturers of electrical material throughout the United States to save the Scrap Copper Wire, Scrap Brass, Platinum, etc., and ship to us. We are established for many years in the buying of scrap material, and are facilitated for handling any quantity, for which we always pay the highest value according to the market We pay prompt cash on receipt and inspection.

We also supply the electrical trade with our high-grade Babbitt Metals, Bar and Wire Solder, Cotton and Wool Waste. When in want, correspond with us.

SWARTS METAL REFINING CO.,
SMELTERS AND REFINERS,
Office and Works, 20 and 22 N. Desplaines Street, Chicago, Ill.
Established, 1885. Incorporated, 1895.

THE MILLER-KNOBLOCK ELECTRIC MANUFACTURING COMPANY.

COMMUTATORS. ARMATURE COILS.
MAGNET WIRE AND ELECTRO MAGNETS.
WATCH DEMAGNETIZERS. ELECTRICAL REPAIRING.

SOUTH BEND, INDIANA.

FOR SALE.

LOW PRICES. QUICK DELIVERY.

MOTORS.
2 ¼ H.P. 110 v. C & C.
3 ½ " 110 v. C & C.
1 ½ " 110 v. (series) C & C.
2 ¼ " 110 v. (series) C & C.
1 1 " 220 v. Lundell.
1 1 " 220 v. (series) Lundell.
1 1 " 220 v. C & C.
2 1 " 500 v. Detroit.
1 3 " 220 v. Diehl.
2 5 " 220 v. Diehl.
1 5 " 220 v. Gen. Elec.
1 5 H.P. 220 v. C & C.
1 5 " 220 v. C. & W.
3 12 " 110 v. Elec. Dyn.
1 7 " 110 v. Elec. Dyn.
1 15 " 220 v. Com.

DYNAMOS.
1 35-light T.-H.
1 100 " U. S.
2 160 " Elec. Dyn.
1 300 " U. S.
1 500 " Excelsior.
1 8 K.W. Claus.
4 30 " Edison.
1 40 K.W. U. S.
1 35-light Arc T.-H.
1 120 K.W. G. E. alternator.
1 120 " West. alternator.
1 7½ " Eddy D. C. to West. Eng.
1 40 " Eddy D. C. to Payne Eng.
1 50 " Ft. Wayne D. C. to Ball & Wood Eng.
1 10x10x10x12 Dean pump and Wheeler condenser.
1 500 Gal. Worthington Elec. pump, 220 v.

Transformers, Arc Lamps (new), Instruments.

H. J. LINDER & CO., 123 LIBERTY STREET, NEW YORK.

53,500

Telephones in Manhattan and the Bronx.

Telephone Service
Saves Expense at your ***OFFICE,***
Brings Business to your ***STORE,***
Adds to Your Comfort at ***HOME.***

Rates in Manhattan, from $5.00 a Month.

One year contracts. Monthly payments.
NEW YORK TELEPHONE CO.
15 Dey Street. 111 West 38th St

PATENT OFFICE DRAWINGS AND DRAWINGS FOR REPRODUCTION.
ALBERT C. JONES
120 Liberty St. New York

WANTED AND FOR SALE

All kinds of second-hand
Testing Instruments
RALPH VOSE,
25 Sunnyside St., Hyde Park, MASS.

TELEPHONE COMPANIES'
INSULATING
CONDUIT
CABLE
POLE
All Sizes and Kinds
VERY CHEAP
HOSE
WALSH'S SONS & CO. Newark, N. J.

Badt-Goltz Engineering Co.

Suite 1504 Monadnock Block, Chicago.

"Weston" Instruments.
"Leonard" Rheostats and Circuit Breakers.
"Helios-Upton" Arc Lamps.
"Zimdars & Hunt" Panel Boards, Knife Switches, etc.
Searchlights, Carbons,
Rail Bonds, Batteries,
Incandescent Lamps, etc.
Send for Catalogues and Prices.

You can increase the efficiency of your advertising by sending us NEW CUTS frequently.

ELEMENTARY ELECTRO-TECHNICAL SERIES.

BY

EDWIN J. HOUSTON, Ph.D., and A. E. KENNELLY, Sc.D.

Cloth. Price Per Volume, $1.00.

Alternating Electric Currents. Electric Heating. Electromagnetism. Electricity in Electro-Therapeutics. Electric Arc Lighting. Electric Incandescent Lighting. Electric Motor. Electric Street Railways. Electric Telephony. Electric Telegraphy.

Copies of this or any other electrical book published will be sent by mail, postage prepaid, to any address in the world, on receipt of price.

ELECTRICAL WORLD AND ENGINEER, PUBLISHERS 120 LIBERTY STREET, NEW YORK.

ARNOLD ELECTRIC POWER STATION COMPANY,
Engineers and Contractors
For Complete Electric Plants. Results Guaranteed
SUITE 1540 MARQUETTE BLDG., CHICAGO.

BURCH, EDWARD P.
Electric Railway Engineer.
1210 GUARANTY BLDG., MINNEAPOLIS.

CAHOON, JAMES B.
Consulting Engineer.
Gas, Electric Light and Street Railway Plants designed; old plants remodeled; Water Powers developed. Complete plans and specifications furnished.
40 WALL STREET, NEW YORK.

CHAILLET, ADOLPHE A.
Consulting Electrical Engineer.
Plans and specifications for Electric Lighting and Power Plants. Designer of Electrical Machinery.
Manufacturers' Agent.
476 ELLICOTT SQUARE, BUFFALO, N. Y.

Frank R. Ford. George W. Bacon. George H. Davis.
FORD, BACON & DAVIS,
Engineers,
149 BROADWAY, NEW YORK.
Branch Offices:
Liverpool and London and Globe Building, New Orleans, La. Prudential Building, Atlanta, Ga.

HORRY, WILLIAM SMITH,
Electrician and Engineer.
Designer of electrical machinery. Specialty Thermo-Electric furnaces and accessories. Reactance system of arc lighting.
UNION CARBIDE WORKS,
NIAGARA FALLS, N. Y.

HOUSTON & KENNELLY
Electrical Experts and Consulting Electrical Engineers
Estimates, Plans, Specifications, Supervision and Reports, Opinions, Measurements and Tests. Patents. Interferences and Infringements. Offices: CROZER BLDG., PHILADELPHIA, PA. Laboratory, N. 41st St., Philadelphia. Long Distance Telephone, 1-27-12 Philadelphia.
EDWIN I. HOUSTON, Ph. D., A.E. KENNELLY, Sc.D.

HUMPHREY, HENRY H.,
Consulting Electrical Engineer.
Central Lighting Stations,
Electric Power Transmission.
543-544-545 CENTURY BUILDING, ST. LOUIS, MO

MAILLOUX, C. O.,
Consulting Electrical Engineer.
150 NASSAU STREET, NEW YORK.

PELTON ENGINEERING CO.,
Engineers.
CLEVELAND, OHIO.
Consulting, Contracting, Designing, Testing.
Manufacturers' Agents for
MACHINERY AND STATION SUPPLIES.

PEPPER & REGISTER,
General Contractors.
118-116 N. BROAD ST., PHILADELPHIA, PA.
Electric Street Railways a Specialty.

RAE, FRANK B.,
Electrical and Mechanical Engineer,
ALDRICH COURT, 45 BROADWAY, NEW YORK.
Plans, Specifications, Estimates, Valuations, Tests and Reports, Electric Railways, Lighting and Power Transmission.

REID, THORBURN
Consulting Engineer
ELECTRICAL—Power Transmission, Electric Railways, Central Stations, Isolated Plants, Machine Design. HYDRAULIC—Water Power Development. REFRIGERATING—Complete Ice Manufacturing or Cold Storage Plants.
120 LIBERTY STREET, N. Y. CITY.
Telephone, No. 2708 Cort.

SARGENT & LUNDY,
Engineers.
1140 MONADNOCK BLOCK, CHICAGO.
FREDERICK SARGENT. A. D. LUNDY.

SHEAFF & JAASTAD,
Mechanical and Electrical Engineers.
Plans and specifications for and superintendence of Electric Power and Lighting Plants a specialty.
85 WATER STREET, BOSTON, MASS.

SMETHURST & ALLEN,
Electrical Engineers and Contractors.
1222 and 1223 STEPHEN GIRARD BLDG., PHILADELPHIA, PA. Long distance telephone, 3898. Complete Electric Light and Power Installations. Electric Railway Work a Specialty.
W. A. SMETHURST. RODNEY D ALLEN.

THAYER CO., R. LESTER,
Engineers and Contractors.
Tel. 377. PEORIA, ILLINOIS.

WAGNER, HERBERT A.,
Consulting Electrical & Mechanical Engineer
Designs, Specifications and Superintendence for Plans and Works of All Kinds. Central Station Lighting and Railway Work a Specialty.
No. 415 Locust St., St. Louis, Mo.
Long Distance Telephone, St. Louis, 860 Main
New York Office, No. 26 Cortlandt St.

WARREN, A. K.
Consulting Engineer
Expert on Electrical Machinery. Estimates Upon Cost of Installations, etc. Correspondence Invited.
Telephone 2059 Cortlandt.
120 LIBERTY STREET, NEW YORK

WHITE & COMPANY, J. G.,
Incorporated.
Engineers, Contractors,
29 BROADWAY, NEW YORK, N. Y.
Equitable Bldg., Baltimore.

POWERS'
CENTRAL STATION STREET RAILWAY **DIRECTORIES**
Complete, up-to-date manuals for financial, Official, Electrical and Mechanical Reference.
The E. L. POWERS CO., PUBLISHERS,
150 Nassau St., New York.

Consulting and Contracting Engineers,
Electrical Engineers of all classes,
Superintendents of Electric Lighting Stations,
Superintendents of Telephone Exchanges,
Superintendents of Electric Street Railways,
Large Manufacturers, Dealers and Importers of Electrical Apparatus

In all parts of the world are reading
ELECTRICAL WORLD AND ENGINEER.

MEN WHO THINK

will readily see the superiority of Viaduct Apparatus. Take for example this fine instrument our

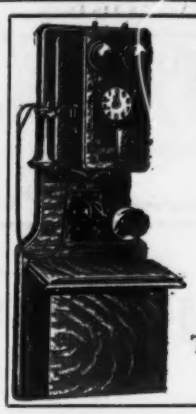
No. 10 TELEPHONE

with extra standard 12,000 ohms, magneto bell, automatic, long lever switch with platinum points, arm transmitter, for long and short distances; standard hard rubber shell, single or bi-polar, receiver with silk or worsted cord, double battery box back board.

We also manufacture District Messenger Call Boxes and Fire Alarm Boxes.

VIADUCT MAUFACTURING CO.,
BALTIMORE, MD.

NEW YORK OFFICE: 136 Liberty Street, DAVID CHALMERS, Representative.



Do You Want

A service that is quick and true?
To escape from the dependence upon the pleasure of central operator?
The same speedy service by night and by day?
An investment that is safe and profitable?

Use the :

National Automatic Telephone.

For information write

The National Automatic Telephone Company,
153-155 W. Jackson Boulevard, CHICAGO, ILL.

MAGNETS. Telephone Induction Coils, Ringer and Bridge Bell Magnets, Drop Magnets, &c. Also Gas Lighting Spark Coils.

THE VARLEY DUPLEX MAGNET CO.,
Chicago, 505 Fisher Bldg. 138 7th St., Jersey City, N. J

Steel Spring Wire

Our Music Wire having High Tensile strength and Absolute Uniformity is excellent for Springs.

HAMMACHER, SCHLEMMER & CO., IMPORTERS,
209 BOWERY, NEW YORK.
Correspondence Solicited.

Kokomo Telephones

Represent the highest stage of improvement in telephony. . .

Conversation is transmitted CLEAR and DISTINCT, and without sputtering or squeaking noises.

Our telephones are working successfully over difficult lines where others have failed.

We manufacture private lines and exchange equipments complete.

Ask for Illustrated Catalogue.

Kokomo Telephone & Electric Mfg. Co.
KOKOMO, IND., U. S. A.

HUGO SCHUMACHER, Prest. MAX SCHUMACHER, Sec'y and Treas.
J. A. ARBOGAST, Vice-Prest. M. GARL, Supt.

GARL ELECTRIC COMPANY,
AKRON, OHIO.

SOLE PATENTEES AND MANUFACTURERS OF...

Garl Railway, Hotel and Factory Telephone Systems. Garl Electric Gun for Fire and Burglar Alarms.

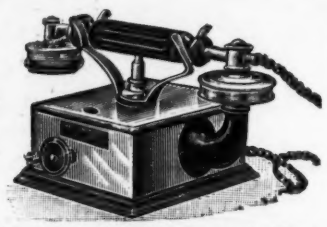
Hotel or Factory Telephone.

Intercommunicating Telephone.

VICTOR TELEPHONE WORKS.

Manufacturers of the highest grade telephone apparatus procurable for use by operators of independent exchanges in the United States. Correspondence solicited. Address

203 to 207 SOUTH CANAL STREET, CHICAGO.



No. 122. Schmidt Automatic Reset Intercommunicating Telephone.

THE
LAMBERT & SCHMIDT TEL. MFG. CO.
325 Broadway, New York

Telephones and Switchboards
— FOR —
Interior and Exchange Purposes

THE PIONEER MANUFACTURERS OF INTERIOR TELEPHONES

THE SIMPLEX INTERIOR TELEPHONE CO.
431 MAIN ST. CINCINNATI, O.

High Grade Telephones

For Intercommunicating, Hotel, Residence, Short Line, and Street Railway Service.

WRITE FOR PRICES AND CATALOGUE CONTAINING REFERENCES AND TESTIMONIALS. AGENTS WANTED.

An intending purchaser of electrical apparatus anywhere always consults this paper's advertising pages to ascertain who makes what he wants. ELECTRICAL WORLD AND ENGINEER is recognized in every country of the world as the leading electrical journal.

J. H. VAN VLISSINGEN, President. W. C. HEINROTH, Treasurer.
L. G. WHEELER, Vice-President. L. G. BOWMAN, Sec'y and Gen'l Manager.

Western Telephone Construction Co.,
153-159 SOUTH JEFFERSON ST., CHICAGO, ILL.

FOR HEAVY WORK YOU NEED
OUR NEW
Western Express No. 3 Five-Bar
BRIDGING TELEPHONE.

The Best on the Market. **Notice Some of the Good Points:**

HEAVIEST GENERATOR IN USE
WIDE CUT GEARS.
HEAVY CAST BEARINGS.
SILK WOUND ARMATURE.
PLATINUM CONTACT SWITCH HOOK.
RECEIVER WITH NO EXPOSED METAL PARTS.
FINEST ADJUSTABLE ARM MADE.
TRANSMITTER WITH CAST BRASS FRONT.
RINGERS 1200 and 1600 OHMS.
MAGNETO BOXES CAN BE REMOVED FROM BACKBOARD WITHOUT CUTTING WIRES
ALL INSTRUMENTS GUARANTEED.

WRITE FOR PRICES. . . . ORDERS FILLED PROMPTLY.

No central office expense.

■■■

Any number of conversations may be carried on at the same time without interfering with each other.

■■■

All connections made at the will of the person calling.

■■■

DESK SET.

Uninterrupted service day and night.

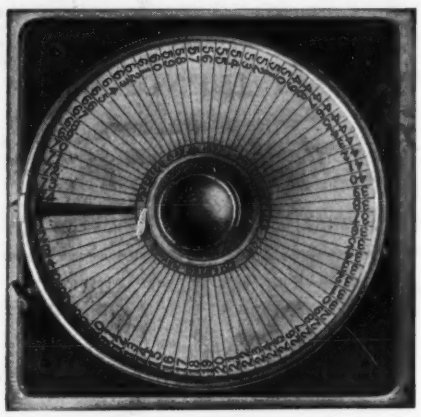
■■■

Has been thoroughly tested by actual use.

■■■

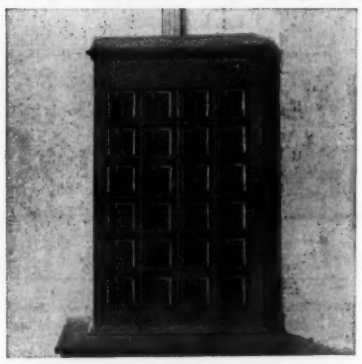
Plants now in process of installation.

■■■

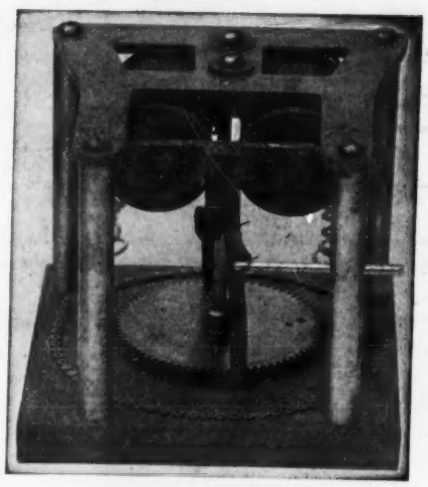


CLARK AUTOMATIC TELEPHONE DIAL
TO OPERATE 75 TELEPHONES

The simplest, most economical and efficient automatic system for inside and small town work.



CLARK AUTOMATIC SWITCHBOARD
LOCATED AT 332 CONGRESS ST., BOSTON MASS.
SYSTEM OF 24 TELEPHONES.



CLARK AUTOMATIC TELEPHONE SWITCH
TO OPERATE 75 TELEPHONES.

FOR

TOWNS
FARMERS' LINES
FACTORIES
WAREHOUSES

FOR

HOTELS
OFFICES
PUBLIC BUILDINGS
STEAMSHIPS

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD CO.

Banigan Bldg., - Providence, R. I

Watch our Ads. *Investigate Our System* *Write for Particulars*

Telephones and Switchboards

FOR ANY SIZE EXCHANGE

"CENTRAL ENERGY" SYSTEM

MULTIPLE SWITCHBOARD

Correspondence Solicited

THE STROMBERG-CARLSON TEL. MFG. CO.

70-82 W. JACKSON BOUL.
CHICAGO, U. S. A.

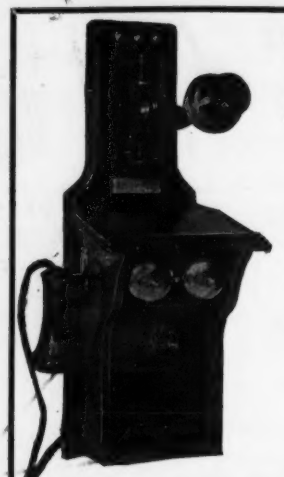
START THE NEW YEAR RIGHT
by equipping your exchange with

KELLOGG TELEPHONE APPARATUS

Portable Desk Phone.

In the Twentieth Century use
Twentieth Century Apparatus.
Guaranteed in every particular.

KELLOGG SWITCHBOARD AND SUPPLY CO.,
231 SO. GREEN ST., CHICAGO.



THE NORTH SUPERVISORY System

For all SIZES of EXCHANGES.

IT
Reduces Number of Operators.
Increases Speed of Connections.
Saves Time of Subscriber.
Has no Bad Clicks in the Ear; and
Has Smallest Consumption of Battery.

PAYS DIVIDENDS

Write for Particulars.

THE NORTH ELECTRIC CO.,
361-373 Frankfort Street, CLEVELAND, OHIO.

NOW READY

Third Edition American Telephone Practice.

$3.00
518 Large Octavo Pages

Revised and Greatly Enlarged

$3.00
380 Illustrations

BY KEMPSTER B. MILLER, M. E.

The new matter includes a comprehensive treatise on the care of Storage Batteries, about twenty pages being devoted exclusively to this important subject alone

Another important feature is a complete set of specifications for the building of both large and small exchanges, and covering all branches of the work from underground conduits to the winding of ringer coils. No good set of telephone specifications has ever before been published, and this chapter alone is worth the price of the book.

ELECTRICAL WORLD & ENGINEER, 120 Liberty St., New York.

Telephone Switchboards

and New-Type, up-to-date

MAGNETO BELLS

ALSO PARTS FOR MAKING TELEPHONE SWITCHBOARDS

For particulars and prices apply to the

UTICA FIRE ALARM TELEGRAPH CO., - - UTICA, N. Y.

IT IS CHEAPER

to buy a telephone equipment, F. O. B. Factory, and install it yourself.

Such apparatus, of course, needs to be simple and substantial, and therefore must be economical to operate.

This exactly describes our Central Energy System. Anyone can install and operate it.

WRITE US

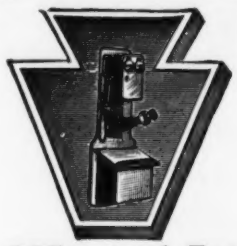
The Fowler Telephone and Engineering Co.

325 BROADWAY, NEW YORK

TELEPHONES The Name COUCH & SEELEY Co. SWITCHBOARDS

GUARANTEES SUPERIORITY

BOSTON, MASS.



KEYSTONE ELECTRIC TELEPHONE CO.

...High Grade...

TELEPHONES AND SWITCHBOARDS

Exchanges Equipped in every Detail.

POLICE AND FIRE ALARM SYSTEMS

Office and Factory, 565 Old Ave., Pittsburg, Pa.

The men with whom you wish to do business are readers of ELECTRICAL WORLD AND ENGINEER.

NOW READY

CATALOGUE 17

Showing Complete Lines in Electric Bells, Batteries, Telephone, Telegraph and General House Goods Supplies. . . . . .

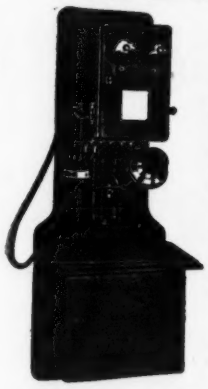
E. B. LATHAM & CO.

NEW YORK

NORTHWESTERN TELEPHONE MFG. CO.,

Canal and Jackson Sts.,

.....CHICAGO.



Telephones, Switchboards, Magneto Bells, etc. Over 15 years of practical experience in the service with the licensees of the American Bell Telephone Co., a sufficient guarantee of the safety and efficiency of our apparatus. All of our telephones are equipped with a Solid Back Transmitter, identical in principle with that utilized by the American Bell Telephone Co. for transmitting articulation a distance of 2,000 miles.

Send for Prices and Mention this Paper.

FUSES, FUSE BLOCKS, TELEPHONE SUPPLIES.

American Electric Fuse Co.,

345 So. Canal St., Chicago, Ill.

A PERFECT TELEPHONE METER SYSTEM

Our system keeps accurate record of calls on a small register at the subscriber's station and each subscriber's register reading is taken by our portable record taker at the central office each month.

THE NATIONAL MEASURED SERVICE CO.,
1039 Marquette Building, Chicago, Ill.

When writing to advertisers please mention ELECTRICAL WORLD AND ENGINEER.

THE BRUCKNER ELECTRIC CO.

(Incorporated.)

Manufacturers of High-Grade Interior and Long-Distance

TELEPHONES, SWITCHBOARDS.

The very latest Hotel Telephone System and Automatic Intercommunicating Telephone. Reasonable Prices. Prompt Shipments.

THE BRUCKNER ELECTRIC CO., General Office and Factory, 141 to 155 East 25th St., New York.

MAGNET WIRE

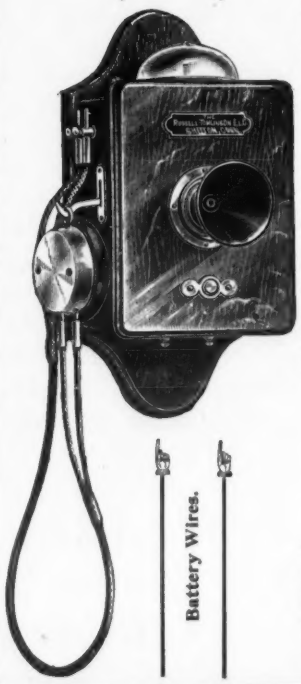
Single and Double Silk and Cotton Insulated Wire in Stock.

THE MC DERMID MFG. CO.

207 So. Canal St. Chicago, Ill.

Line Wire.

Return Line Wire.



THE WONDER OF THE WORLD:

How our "NEW STANDARD" Phones can be MADE SO WELL and SOLD SO CHEAPLY!!

Highly finished cases of Antique or Golden Oak. All metal parts nickel plated and polished. 4-Ohm Vibrating Bells. Double-pole watch-case Receivers. Solid back Transmitters. Anti-Twist Binding Posts. **Thoroughly Guaranteed.**

per pair, **$7.50** (two phones.)

Big Discount to Dealers. . . . . .

Our Catalog tells the whole story, get one.

Battery Wires.

Battery Wires.

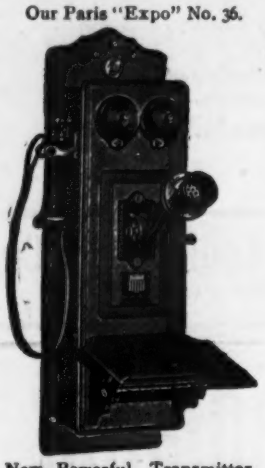
RUSSELL-TOMLINSON ELEC. CO.,

MILFORD, CONN., U. S. A.

The American Electric Telephone Co.,

Our Paris "Expo" No. 36.

36 to 50 Jackson Boulevard CHICAGO,



Manufacturers of a FULL LINE OF

High-Class Telephone Apparatus,

New Powerful Transmitter. Concealed cord. Bridging and series. Very compact.

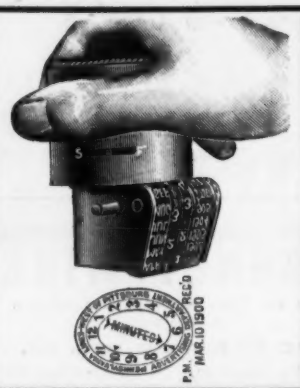
INCLUDING

All Types of Telephones and Switchboards.

OUR MULTIPLE BOARDS WITH FULL SYSTEM OF SUPERVISORY FLASH-LIGHT SIGNALS and

CENTRAL ENERGY PHONES

ARE LEADING THE PROCESSION.



Keep track of your toll line connections and your inspectors' trips with our

Emerson Line Stamp.

We have special facilities and knowledge for doing experimental work in the line of Telephones, Switchboards, etc. Die and Tool Work and Fine Gear Cutting.

Capps Mfg. Co.

100 New St. Newark, N. J.

We Manufacture, Import and Export

UP TO DATE

Telephone Apparatus

of Finest Workmanship. Furnished to meet all requirements of service.

Sole Licensee for sale of the **Milde Transmitter** in the United States. Over 100,000 in constant use.

Write for 1900 Catalogue.

STANDARD

Telephone and Electric Company,

MADISON, WIS.

THE ONLY
reasons that the most prominent telephone companies in the United States are using our telephones are—That they are better made, last longer, COST LESS FOR MAINTENANCE, show higher efficiency, make better appearance, please your subscribers better, and make collections easier than any other kind.
SWEDISH-AMERICAN TELEPHONE COMPANY

WE CATER TO THOSE WHO DEMAND THE BEST

If you want supply store and bargain counter apparatus, we can do nothing for you. If you want the best, that is a different story.

Send for our new poster and price list.

SWEDISH-AMERICAN TELEPHONE CO.,

Nos. 69-75 W. Jackson Blvd., Chicago, Ills.

THE

AMERICAN BELL TELEPHONE COMPANY,

125 MILK STREET, BOSTON, MASS.

This company owns Letters Patent No. 463,569, granted to Emile Berliner November 17, 1891, for a combined telegraph and telephone, covering all forms of microphone transmitters or contact telephones.

The Popular Telephone Book of the year.

Practical Features

....of....

Telephone Work

By A. E. DOBBS.

Cloth, 7" by 5¼". Illustrated. 134 pages. Appendix. 75 cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

The price of this book is properly $1.00, but owing to slight imperfections in the binding we are offering it at **75c.**

Sent on receipt of price, postpaid, by

Electrical World and Engineer,

120 Liberty Street, New York.

ENGINE TYPE GENERATOR.

The Hundreds of Users of

C & C TYPE "M. P." GENERATORS AND MOTORS

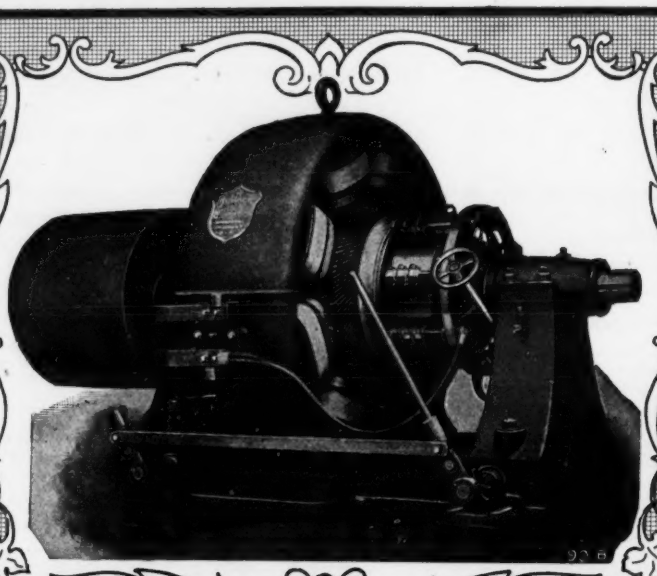
will testify as to their *Undoubted Merit*, and we are constantly getting repeat orders from these users, an evidence of appreciation. *You* will be as well satisfied as *they*. We will gladly quote you prices and send our descriptive bulletins.

The C & C Electric Co.,

SALES OFFICES:
BOSTON—19 High St.
CHICAGO—Monadnock Blk.
PHILADELPHIA—45 N. 7th St.
LONDON—47 Victoria St., Westminster.

MAIN OFFICE:
143 LIBERTY STREET, N. Y.

WORKS: GARWOOD, N. J



20 K. W. Type "H" Bullock Generator.

ELECTRIC POWER.

Convenience and Flexibility.

In an electrically driven works the machines may be arranged as best suits their needs. In any works this is an important factor, especially when the machines are large.

The portable drill, slotter or other machine is a convenience of untold advantage and is not fully appreciated until used.

The generating station may be located at any suitable point and the current carried to the motors in the works by means of a few small wires.

Any portion of the plant may be operated independent of the other. This feature is valuable when running overtime or in slack times when the works is not running full capacity.

Bulletin No. 33 describes Type "H" Bullock Slow and Moderate Speed Generators.

BULLOCK ELECTRIC MFG. CO., CINCINNATI, O., U. S. A.

181 A

LUNDELL MOTORS

require less attention than any other apparatus you can put in your shop. They have never been surpassed in efficiency, durability and ability to stand overload. They have a strong starting torque and an accurate adjustment of speed. They are non-sparking, compact and reliable. Full description in Catalogue No. 583.

SPRAGUE ELECTRIC COMPANY

GENERAL OFFICES: 527-531 West 34th Street, NEW YORK

CHICAGO: Fisher Building ST. LOUIS: Security Building BOSTON: 275 Devonshire St.

. PUBLICATIONS OF .

Electrical World and Engineer

120 Liberty Street, New York, U. S. A.

Algebra Made Easy.—Houston and Kennelly.
101 pages, with diagrams..... $0.75

Alternating Current Phenomena.—Steinmetz.
Third edition, revised and enlarged (in press)..... 4.00

Alternating Current Wiring and Distribution.—Emmet.
Second edition. 98 pages, 33 illustrations..... 1.00

Alternating Currents.—Houston and Kennelly.
(Electro-Technical Series.) Second edition. 225 pages, 77 illustrations 1.00

Alternating Currents of High Potential and Frequency.—Tesla.
146 pages, 35 illustrations..... 1.00

American Street Railway Investments.
Published annually 5.00

Arc Lighting.—Houston and Kennelly.
(Electro-Technical Series.) 383 pages, 155 illustrations..... 1.00

Central Station Bookkeeping.—Foster.
139 pages, 123 forms..... 2.50

Dictionary of Electrical Words, Terms and Phrases.—Houston.
Encyclopedic edition. Fourth edition. 990 pages, 582 illustrations.. 7.00
Pocket edition, 945 pages. Cloth, $2.50.....Leather 3.00

Dynamo-Electric Machines, Practical Calculation of.—Wiener.
683 pages, 375 illustrations, 105 tables..... 2.50

Dynamo Machinery, Original Papers on.—Hopkinson.
249 pages, 98 illustrations..... 1.00

Dynamos and Motors, Shop and Road Testing of.—Parham and Shedd.
520 pages, 163 illustrations..... 2.00

Dynamo and Motor Building for Amateurs.—Parkhurst.
163 pages, 73 illustrations..... 1.00

Electric Heating.—Houston and Kennelly.
(Electro-Technical Series.) 298 pages, 86 illustrations..... 1.00

Electric Lighting Specifications.—Merrill.
213 pages 1.50

Electricity Made Easy.—Houston and Kennelly.
348 pages, 207 illustrations..... 1.50

Electric Motor.—Houston and Kennelly.
(Electro-Technical Series.) 377 pages, 122 illustrations..... 1.00

Electric Railways.—Houston and Kennelly.
(Electro-Technical Series.) 367 pages, 158 illustrations..... 1.00

Electric Railway Engineers' Reference Book.—Merrill.
128 pages, interleaved 1.00

Electric Railway Motors, Modern.—Hanchett.
200 pages, 157 illustrations..... 2.00

Electric Railway Motors.—Perry.
175 pages, 140 illustrations..... $1.00

Electric Railway Power Distribution.—Bell.
268 pages, 139 illustrations. Third edition..... 2.50

Electrical Engineering Leaflets.—Houston and Kennelly.
ELEMENTARY GRADE—296 pages, 121 illustrations..... 1.50
INTERMEDIATE GRADE—300 pages, 140 illustrations..... 1.50
ADVANCED GRADE—296 pages, 121 illustrations..... 1.50

Electricity and Magnetism.—Gerard, Steinmetz, Kennelly and Hutchinson.
392 pages, 112 illustrations 2.50

Electricity 100 Years Ago and To-day.—Houston.
199 pages, illustrated..... 1.00

Electro-Dynamic Machinery.—Houston and Kennelly.
331 pages, 232 illustrations..... 2.50

Electro-Therapeutics.—Houston and Kennelly.
(Electro-Technical Series.) Second edition, enlarged. 452 pages, 147 illustrations 1.00

Incandescent Lighting.—Houston and Kennelly.
(Electro-Technical Series.) 449 pages, 146 illustrations..... 1.00

Index to the Electrical World.
(From January 1, 1883, to January 1, 1897.) 372 pages..... 8.00

Interpretation of Mathematical Formulae.—Houston and Kennelly.
225 pages, 9 diagrams..... 1.25

Magnetism.—Houston and Kennelly.
(Electro-Technical Series.) 294 pages, 94 illustrations..... 1.00

Primers of Electricity.—Houston.
ELECTRICAL MEASUREMENTS. 429 pages, 169 illustrations.... 1.00
ELECTRICAL TRANSMISSION OF INTELLIGENCE. 330 pages, 88 illustrations 1.00
ELECTRICITY AND MAGNETISM. Second edition. 318 pages, 117 illustrations 1.00

Recent Types of Dynamo Electric Machinery.—Houston and Kennelly.
612 pages, 435 illustrations 5.00

Street Railway Roadbed.—Pratt and Alden.
135 pages, 157 illustrations 2.00

Telegraphy.—Houston and Kennelly.
(Electro-Technical Series.) 448 pages, 164 illustrations..... 1.00

Telephony.—Houston and Kennelly.
(Electro-Technical Series.) 412 pages, 143 illustrations..... 1.00

Telephone Practice, American.—Miller.
Third edition, revised and enlarged..... 3.00

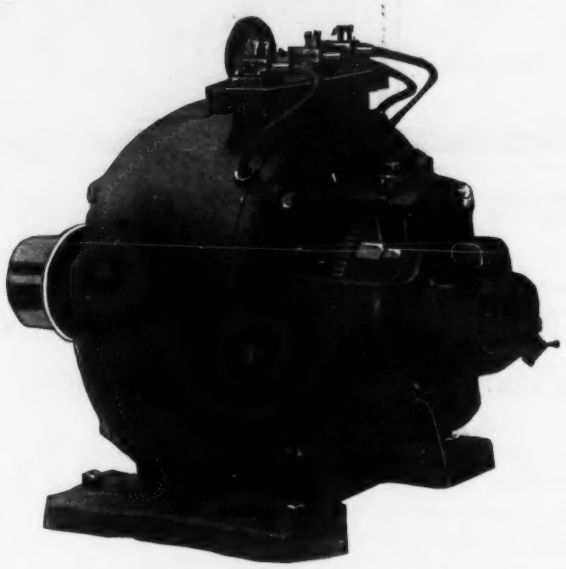
Telephone Work, Practical Features of.—Dobbs.
134 pages, 61 illustrations ..... .75

Wiring Computer, Universal.—Hering.
44 pages, 4 charts 1.00

Copies of any of the above books or of any other electrical book published will be sent by mail, POSTAGE PREPAID, to any address in the world on receipt of price.

ELECTRICAL WORLD AND ENGINEER, 120 LIBERTY STREET, NEW YORK.

WHEN CONDITIONS ARE SUCH



ONE-HALF H. P. A. C. MOTOR

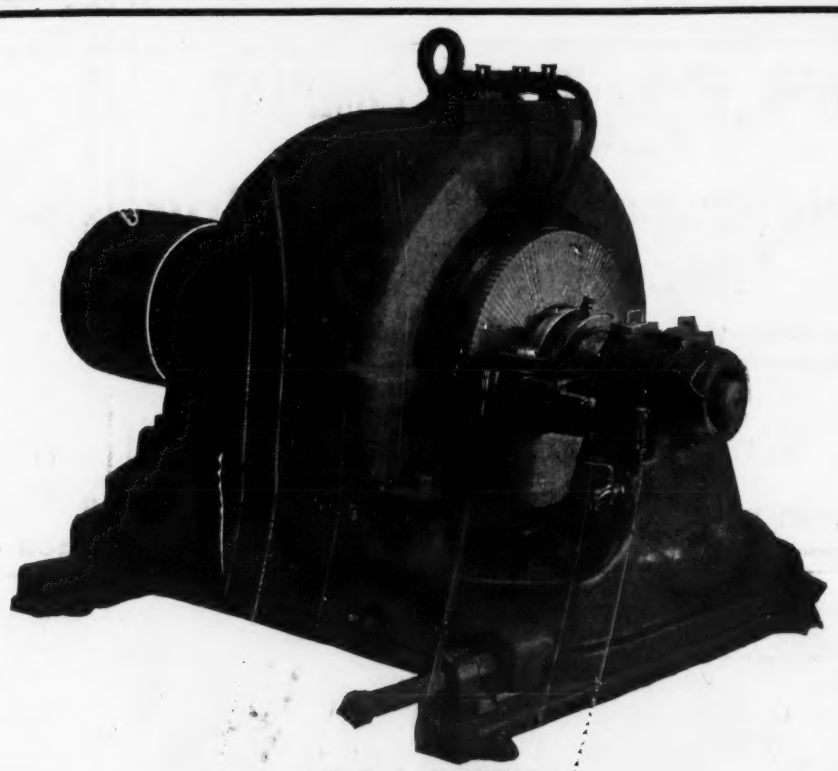
That it is not possible to give a motor close attention our Single Phase A. C. Motors are peculiarly adapted to this class of service .. ..

NO AUXILIARY DEVICE
.. .. OF ANY KIND USED .. ..

THE ATTENDANT
SIMPLY CLOSES THE MAIN LINE SWITCH

THE MOTOR TAKES CARE OF ITSELF

BULLETINS G-24, 35, 37 and 39 WILL TELL YOU ALL ABOUT THESE MOTORS



10 H. P. A. C. MOTOR

WAGNER ELECTRIC MFG. CO.

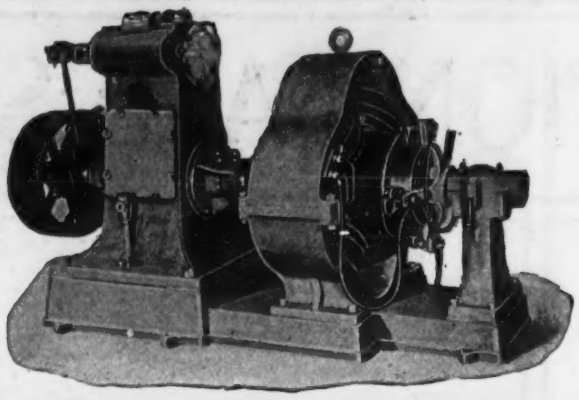
General Offices and Works: ST. LOUIS, U. S. A.

BRANCH OFFICES:

NEW YORK, 220 Havemeyer Building.
PHILADELPHIA, 1000 Betz Building.
BOSTON, 620 Atlantic Avenue.
CHICAGO, 1624 Marquette Building.
BALTIMORE, 204 East Lexington Street.
SAN FRANCISCO, 120 Sutter Street.
NEW ORLEANS, 510 Gravier Street.

FOREIGN AGENCIES:

FOREIGN DEPARTMENT, Havemeyer, Bldg., New York City.
CITY OF MEXICO, MEX., American Engineering Co., Mexico, Agts.
LONDON, ENGLAND, 47 Victoria St., C. R. Heap, Agent.
YOKOHAMA, JAPAN, Bagnall & Hilles, Agents.
PARIS, FRANCE, 12 Rue St. Georges, E. H. Cadiot & Cie., Agents.



THE ONONDAGA DYNAMO CO. SYRACUSE, N.Y., U.S.A.

Write us For Catalogues and Prices.

Commercial Motors

FOR ALL PURPOSES

GUARANTEED JUST RIGHT

Used Everywhere

Commercial Electric Co.

19 W. Merrill St., Indianapolis, Ind.

F. C. ROSS, 255 Greenwich St., NEW YORK

L. J. OSBORNE, 1200 Fisher Bldg., CHICAGO

IN WRITING TO ADVERTISERS Subscribers will confer a favor on us and also on the advertisers by mentioning that they saw the advertisement in ELECTRICAL WORLD AND ENGINEER.

H. H. PENNER, President. J. F. BLAUVELT, Agent. RUSSELL W. KNIGHT, Treasurer.

NEW ENGLAND BUTT COMPANY,

MANUFACTURERS OF

Machinery for Insulating Electrical Wires.

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders.

FINE CASTINGS A SPECIALTY.

304 Pearl Street, · · PROVIDENCE, R. I., U. S. A.

RECENT TYPES OF DYNAMO-ELECTRIC MACHINERY

By EDWIN J. HOUSTON, Ph.D., and A. E. KENNELLY, Sc.D.

Profusely Illustrated with over 600 Magnificent Engravings by the best known Process, shown in Color, including Tables of exceptional Value.

CONTENTS.

CHAPTER I.—Introduction. II.—Direct-Driven Continuous Current Generators for Isolated Plants. III.—Belt-Driven Continuous Current Generators for Isolated Plants. IV.—Continuous Current Central Station Generators. V.—Central Station Arc Light Generators. VI.—Some Miscellaneous Types of Continuous Current Generators. VII.—Alternating Current Generators. VIII.—Multiphase Alternators. IX.—Alternating Current Transformers. X.—Continuous Current Motors. XI.—Locomotors. XII.—Alternating Current Motors. XIII.—Regulators for Alternating Current Circuits. XIV.—Secondary Generators.

Cloth. 612 Pages, 435 Illustrations. Price, $5.00.

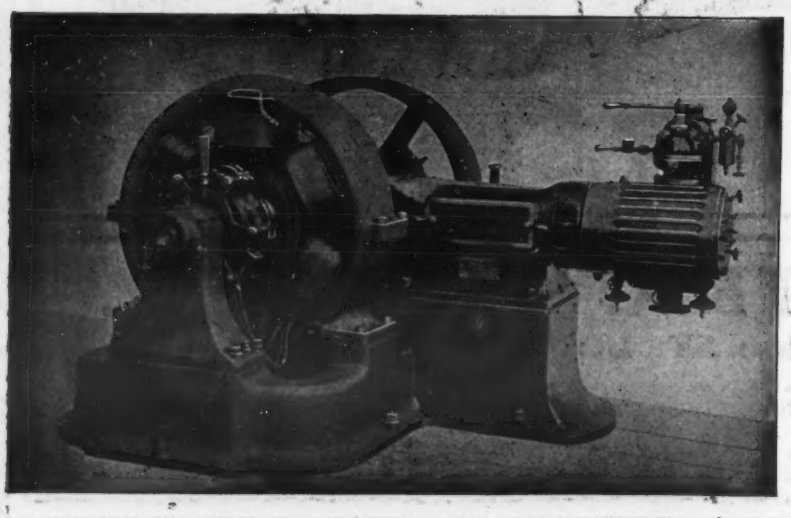
Although many books have been written on the subject of dynamo-electric machinery, yet, so far as the authors are aware, none have yet appeared that have been devoted *entirely to American types of machines;* or, at least, none in which these have been treated from an entirely practical standpoint, with copious illustrations, enabling the reader to form precise ideas concerning the exact appearance, function and behavior of American machines. The book is not a treatise concerning the principles of dynamo-electric machinery, or the theory of its operation, but a descriptive treatise of the various types of machines made by different manufacturers, with their sizes, data, functions and capabilities.

In describing the various machines, attention has particularly been given to the practical rather than to the theoretical side of the subject. For this reason the book is readily capable of comprehension by those who have not had collegiate training, and is not limited, as many books on dynamo-electric machinery necessarily are, to those skilled in electro-technics.

Copies of this or any other electrical book published will be sent by mail, postage prepaid, to any address in the world, on receipt of price.

ELECTRICAL WORLD AND ENGINEER, Publishers,

120 Liberty Street, New York.



Akron Dynamos and Motors

HIGHEST EFFICIENCY MODERN CONSTRUCTION

Direct connected, slow and moderate speed, are of the highest efficiency, most modern construction and graceful design. Our guarantee is liberal and satisfying. Our prices are right.

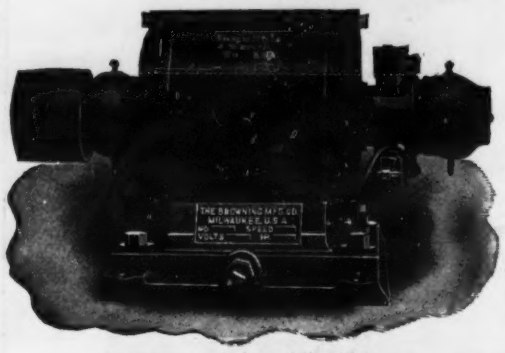
Send for descriptive bulletin No. 30, also No. 429, describing our commutator Truing Device.

Akron Electrical Manufacturing Co.

AKRON, OHIO

HIGH GRADE MOTORS AND DYNAMOS

PROTECTED TYPE, SPHERICAL STEEL FRAMES



From 1-4 H. P. to 1 1-2 H. P.

We make Motors as small as 1-12 H. P

Send for Bulletins

THE BROWNING MFG. CO.
MILWAUKEE, U. S. A.

New York Office: 321 Havemeyer Bldg., M. E. Baird, Agt.

Chicago Office: 1804-1812 Fisher Bldg., Kohler Bros., Agts.

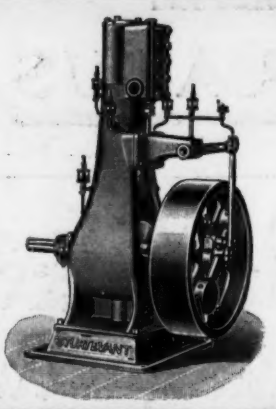
BOOKS On Electrical Subjects

Mailed to any address in the world, POSTAGE PREPAID, on receipt of price.

Address ELECTRICAL WORLD & ENGINEER
120 LIBERTY STREET, NEW YORK

STURTEVANT ENGINES

Our Specialty: High grade engines of medium capacity for high or low pressure. 60 sizes under 200 H. P.

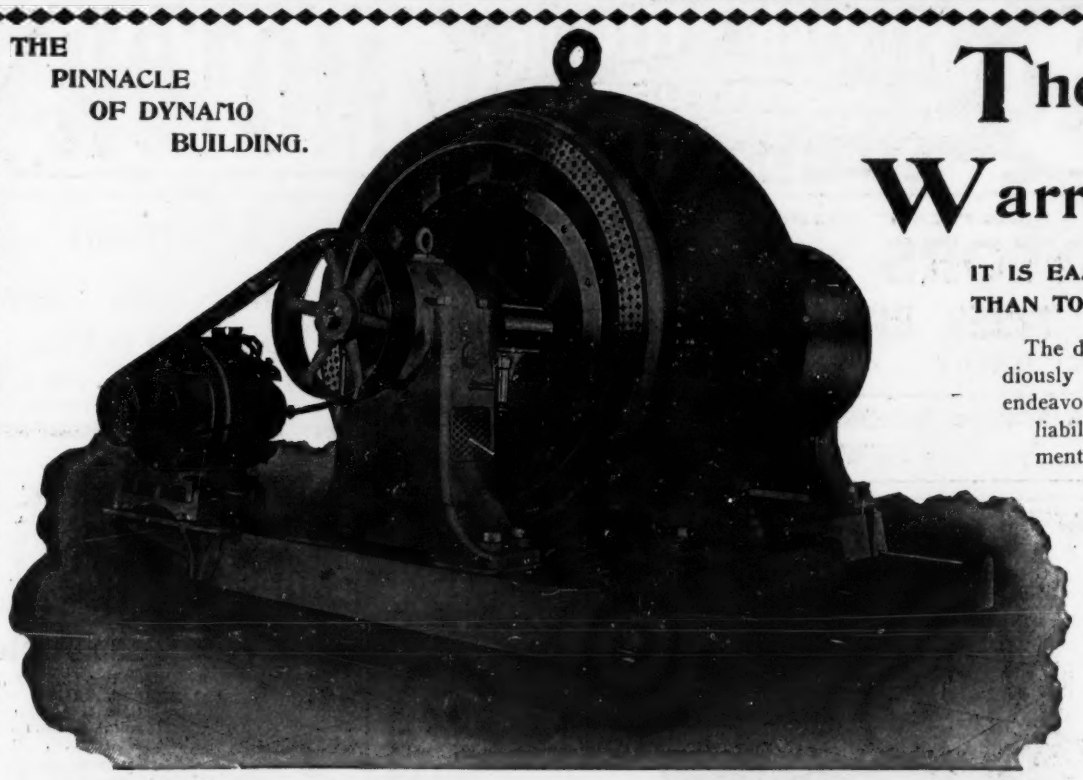


—ALSO—
Blowers
Exhausters
Steam Fans
Electric Fans
Electric Motors
Generating Sets
Forges
Exhaust Heads
Steam Traps
Heating
Ventilating and
Drying Apparatus
Mechanical Draft

152

B. F. STURTEVANT CO. BOSTON.
NEW YORK · PHILADELPHIA · CHICAGO · LONDON ·

THE PINNACLE OF DYNAMO BUILDING.



The Improved Warren Alternator

IT IS EASIER TO INVENT COMPLICATIONS THAN TO PRESERVE PRACTICAL SIMPLICITY.

The designers of the Warren Alternator have studiously avoided intricate, delicate and costly parts, endeavoring in every way to preserve simplicity, reliability, durability, efficiency and ease of management.

The absence of moving wire, collector rings, commutator and brushes makes the Warren peculiarly well fitted for the exacting conditions of long, continuous service.

No attention required except the occasional refilling of oil reservoirs.

WARREN ELECTRIC MF'G. CO.

SANDUSKY, OHIO.

RUMSEY ELECTRICAL MF'RS CO., 1217 Filbert St., Philadelphia.
H. B. WARREN, Sandy Hill, N. Y. for Northern and Western New York and New England States.
WESTERN ELECTRICAL SUPPLY CO., St. Louis, Mo.
NORTHWEST ELECTRICAL ENGINEERING CO., Portland, Ore.
FESSENDEN & RIDINGER, 410 Penn Ave., Pittsburg, Pa.
C. W. HOBSON, Waco, Texas.
H. B. COHO, 149 Broadway, New York.
SMITH-COURTNEY CO., Richmond, Va.
THOS. MUIR & SON, Detroit, Mich.
J. HOLT GATES & CO., 13-15 Monadnock Blk., Chicago.

BOTH DIRECT AND ALTERNATING CURRENT APPARATUS

S. K. C. and Northern Systems

POWER TRANSMISSION FOR THE GREATEST DISTANCES

Mining, Factory, Railway and Lighting Equipments

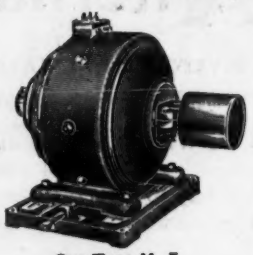
Stanley Electric Manufacturing Co. PITTSFIELD. MASS.

Northern Electrical Manufacturing Co. MADISON. WIS.

L-25-6

GENERATORS — **ELWELL-PARKER ELECTRIC CO.** OF AMERICA MANUFACTURERS GUARANTEES QUALITY CLEVELAND, OHIO. — **MOTORS**

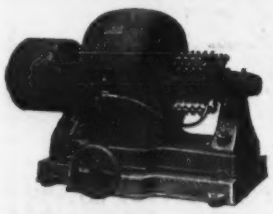
High Grade Slow Speed DYNAMOS AN MOTORS



Our Type M. E.

THE NEW ENGLAND MOTOR CO.

LOWELL, MASS.



Jantz & Leist Electric Co.,

MULTIPOLAR MOTORS AND DYNAMOS.

808-810 ELM ST., CINCINNATI, O. U. S. A.

Write to...

Milwaukee Electric Co.,

MILWAUKEE, WIS.,

For Electrical Machinery. For Power and Lighting.

LATEST IMPROVED TYPE

MOTORS AND DYNAMOS

THREE RIVERS ELECTRIC CO.

OAK STREET - - THREE RIVERS, MICH.

You can increase the efficiency of your advertising by sending us NEW CUTS frequently.

DYNAMOS AND MOTORS

We make bipolar, multipolar and alternating current dynamos and motors; also motors for horseless carriages, cranes, elevators, plating dynamos and rotary transformers.

Send for illustrated catalogue, with price list. A written guarantee with each machine.

2½ H. P. Horseless Carriage and Crane Motor. Weight, 147 lbs.

THE LINCOLN ELECTRIC CO., 71-73 Ontario Street, CLEVELAND, OHIO.

Agents for New York and vicinity, also for Export, Kenny Electrical Mf'g Co., Park Row Bldg., N. Y. City. Cable Address, Kemaco, New York. (3)
Agent for Washington and Oregon, O. H. Pierson, Elma, Wash.

Liverpool and London and Globe Insurance Co.,

William and Pine Sts., NEW YORK.

CLINC-SURFACE

144-150 Virginia St., Buffalo, N. Y. (3)

MAYER MOTORS AND DYNAMOS

For LIGHT, POWER and PLATING, are efficient, simple and reliable. Medium and slow speed.

M. M. MAYER ELEC. CO.

2385—2d Ave., N. Y.

Agents Wanted.

WRITE FOR OUR CATALOGUE OF

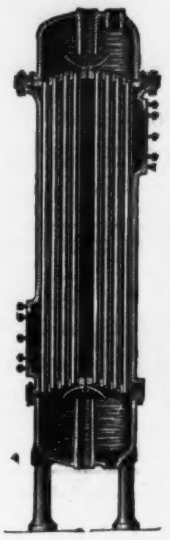
ELECTRICAL BOOKS....

THE **Goubert**

Feed Water Heater

is the result of the best engineering experience in the utilization of exhaust steam.

Meets the requirements of.....
High Pressure Free Exhaust,
Great Durability.



Specially adapted to.....
CONDENSING ENGINES.
All sizes, 50 to 5,000 H. P.

The **Goubert Mfg. Co.**

85 LIBERTY ST., NEW YORK, U. S. A.

IN COMPETITION WITH THE ENTIRE WORLD.

THE ONLY

GOLD MEDAL

GIVEN AT THE

PARIS EXPOSITION, 1900

FOR EXHIBITS OF

VALVES AND FITTINGS

WAS AWARDED TO

CRANE CO.

NEW YORK
PHILADELPHIA
CINCINNATI
KANSAS CITY
SIOUX CITY
OMAHA

CHICAGO

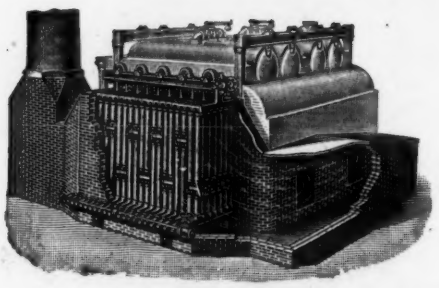
ESTABLISHED 1855

WRITE FOR POCKET CATALOGUE

ST. PAUL
ST. LOUIS
LOS ANGELES
SAN FRANCISCO
PORTLAND, ORE.

Our Sole Product,

GREEN'S ECONOMIZERS



Our Record, 30,000,000 H. P.
Boilers applied to, 200,000

SAVING 10 to 20 PER CENT.

Our List of Users Free.

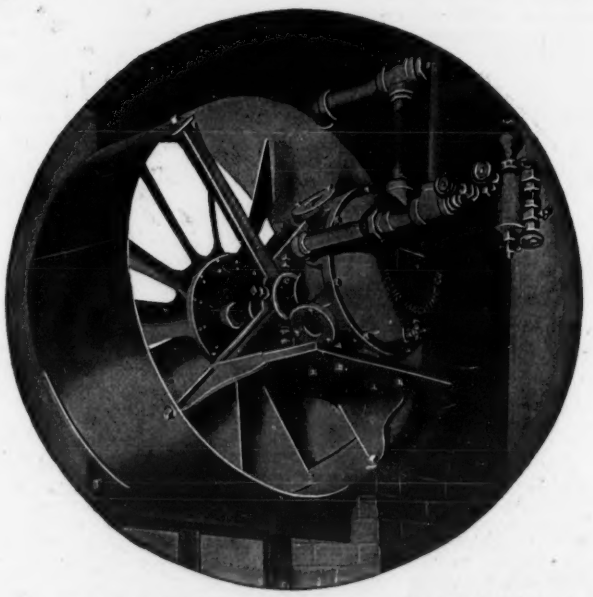
The Green Fuel Economizer Co.

MATTEAWAN, N. Y.

Sole Manufacturers in the U. S. A. (3)

THE VEZIN ENGINE

ESPECIALLY ADAPTED FOR
DIRECT CONNECTION TO
DYNAMOS, FANS, CENTRIFUGAL PUMPS
AND HIGH SPEED MACHINERY.



DIRECT CONNECTED TO 36-INCH VENTILATING FAN

STRENGTH, SPEED, SIMPLICITY AND ECONOMY

THE VEZIN MACHINE CO.,

97 LIBERTY ST., NEW YORK, U. S. A. (1)

Export Business is Paying Business.

The Export Issues of ELECTRICAL WORLD AND ENGINEER (first issue of each month), will bring you export business.

DEARBORN

Drug and Chemical Works.
Laboratories--Water Chemists.
Vegetable Boiler Compounds.

ALL KINDS OF ANALYSES. WATERS FREE. OILS A SPECIALTY.

10,000 Boiler Feed Waters are being treated by Dearborn Methods.

29, 30, 31, 32 & 33 Rialto Bldg., CHICAGO, ILL.

THE LUNKENHEIMER STEAM WHISTLES

SATISFY THE MOST EXACTING.

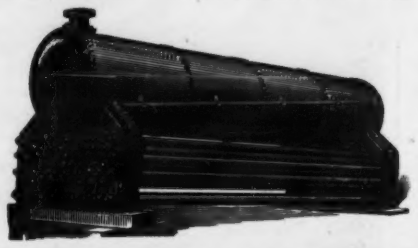
(9)

Single Bell Chime Whistles. 2 to 10 in. diam. of bells. Plain Whistles. 2 to 10 in. diam. of bells. Mocking Bird Whistles. 2½ to 6 in. diam. of bells. Fire Alarm Whistles. 2½ to 8 in. diam. of bells.

All goods tested and warranted first-class. Specify "Lunkenheimer" make and order through your dealer. Write for Catalog.

THE LUNKENHEIMER CO., Sole Makers, Cincinnati, Ohio, U. S. A.

NEW YORK, 26 Cortlandt Street. BRANCH: LONDON, 35 Great Dover Street.



HEINE
Safety Boiler Co.,

421 Olive Street, St. Louis, Mo.

WATER TUBE STEAM BOILERS

Shops at Phœnixville, Pa., Troy, N. Y., St. Louis, Mo., and Chicago, Ill.

11,550 POUNDS OF SCALE

were recently taken from a single boiler by this **CLEANER.**

Write for particulars.

Boilers cleaned by contract

CHICAGO BOILER CLEANER COMPANY, 321 Dearborn St., Chicago, Ill.

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

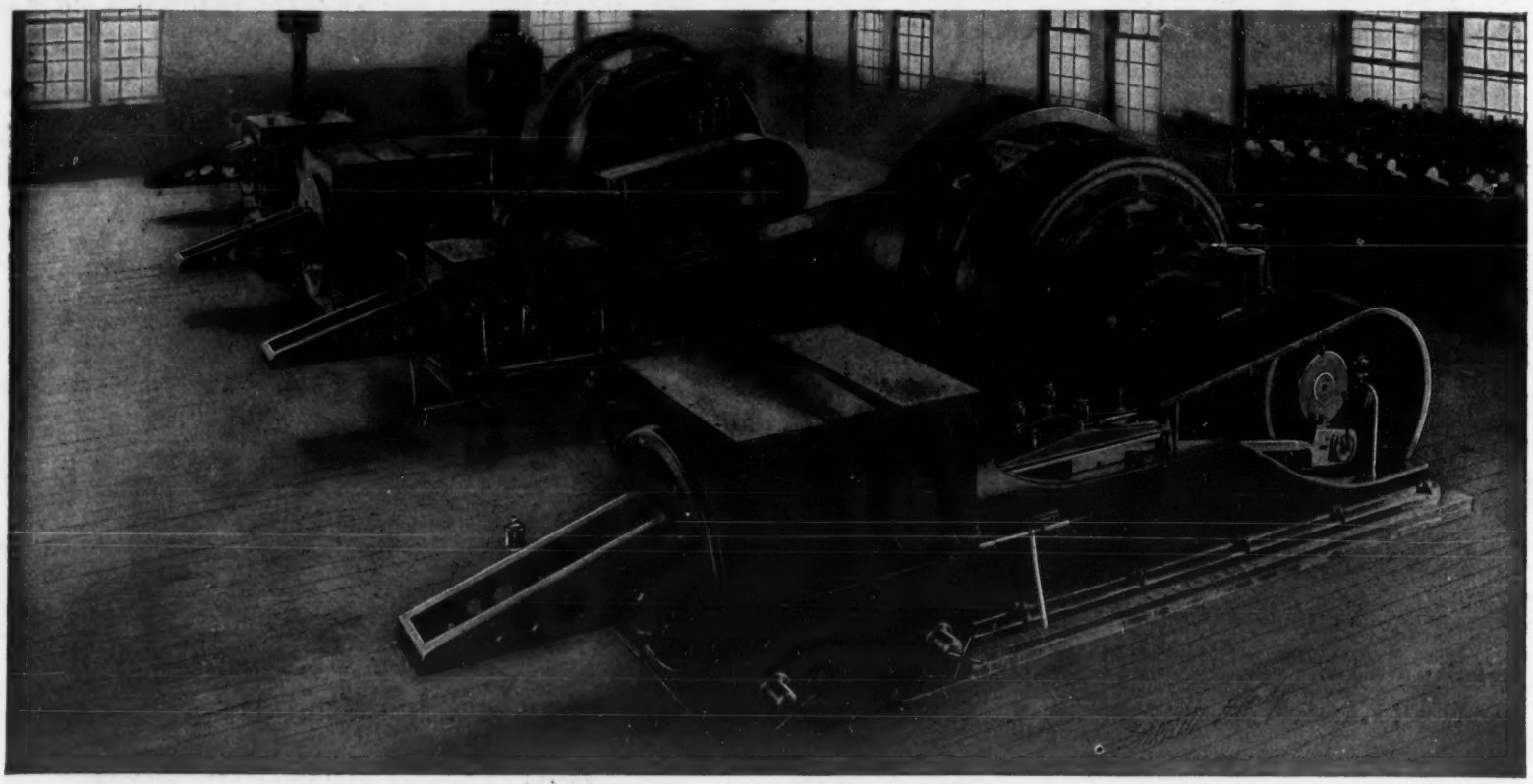
Siegrist Automatic Oiling System

PATENTED

Saves $450 for one Company a month—will save you in proportion to plant .....

SIEGRIST LUBRICATOR CO., ST. LOUIS, MO.

McINTOSH, SEYMOUR & CO., AUBURN, N. Y.



ENGINES, ALL SIZES AND TYPES TO MEET SPECIAL REQUIREMENTS

NEW YORK:
McINTOSH, SEYMOUR & CO.
26 Cortlandt Street

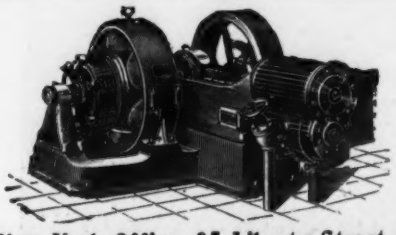
SAN FRANCISCO:
CHARLES C. MOORE & CO.
32 First Street

BOSTON:
J. A. GRANT & CO.
8 Oliver Street

HARRISBURG ENGINES

6 TO 9,000 HORSE POWER
HIGH SPEED, MEDIUM SPEED AND CORLISS

Harrisburg Foundry and Machine Works
HARRISBURG, PA., U. S. A.



AMERICAN-BALL DUPLEX COMPOUND ENGINE
and DIRECT CONNECTED GENERATOR.

A coal-saver of the most practical kind and the most remarkable of recent engines. Don't fail to investigate if you are interested.

We furnish complete equipments consisting of engines, generators and motors of our own manufacture.

New York Office, 95 Liberty Street. AMERICAN ENGINE COMPANY, - - - BOUND BROOK, N. J.

The Priestman Engine.

FOR ALL POWER PURPOSES.
Burns Kerosene Oil; is Safe, Automatic
Durable, Reliable.
Let us tell you more about it.

PRIESTMAN & CO., INC.,
130 BOURSE, - PHILADELPHIA, PA.

The Hatch Electric Smelter

For Smelting Lead and Zinc Ores and Roasting all Ores.
Unequaled for Economy of Fuel and Even Distribution of Heat

HATCH ELECTRIC SMELTING CO.
GREEN BAY, WIS.

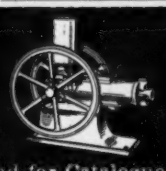
RAINBOW PACKING.

Thousands of Imitators. No Equal. Will Hold Highest Pressure.

Don't have to use wire and cloth to hold Rainbow. Can't blow it out.

THE COLOR OF RAINBOW PACKING IS RED.
Three Rows of Diamonds extending throughout the entire length of each and every roll of Rainbow Packing.
Copyrighted and Manufactured Exclusively by

Peerless Rubber Manufacturing Co.,
16 WARREN STREET, NEW YORK.
16-24 Woodward Ave., Detroit, Mich. 202-210 So. Water St., Chicago, Ill.
17-19 Beale St., and 18-24 Main St., San Francisco, California.



THE MIETZ & WEISS ENGINE
GAS OR KEROSENE—Constant Trust
Safe. Simple. Economical. Automatic. Close Regulation.
Direct Coupled or Belted to Generator and all POWER PURPOSES. 1 to 40 Horse Power.
MARKT & CO. LTD. LONDON, PARIS, HAMBURG AND BERLIN.
A. MIETZ, 128-138 Mott St., NEW YORK.
Send for Catalogue.

WALRATH GAS AND GASOLINE ENGINES
FROM 2 TO 200 H. P.

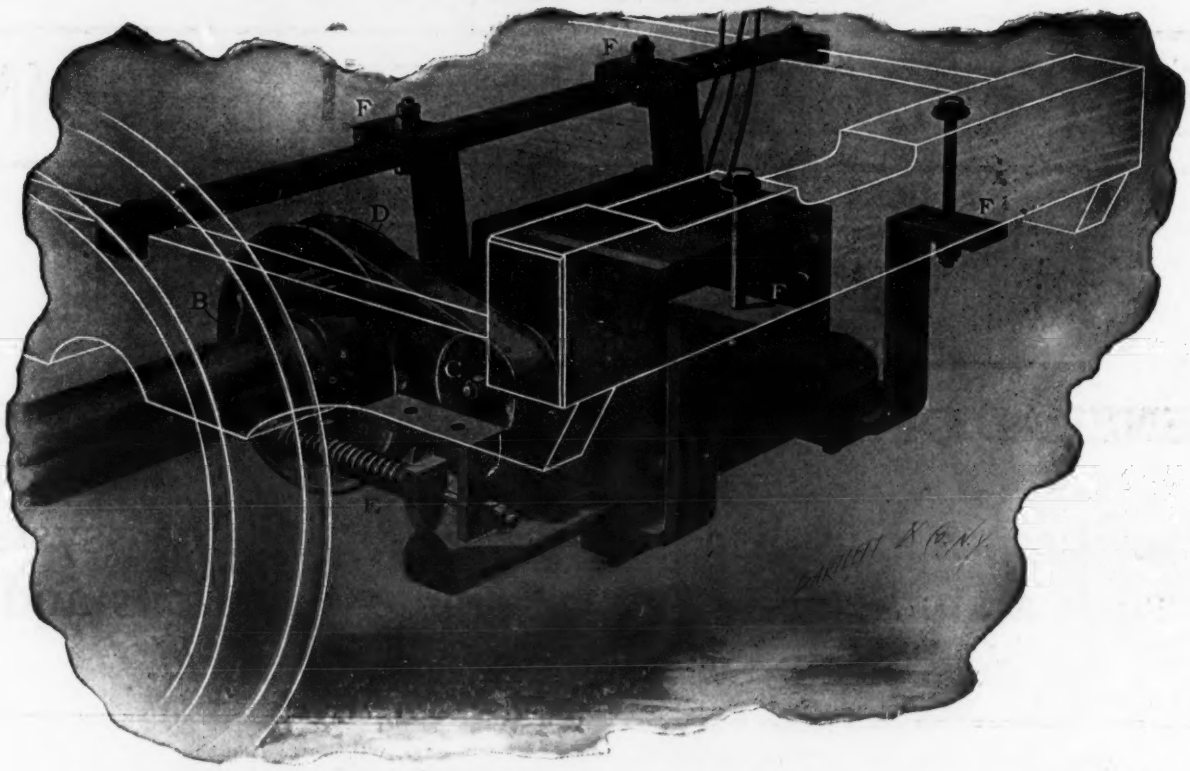
The Gas Engine that holds a Volt Meter as close as a **Steam Engine.** Guaranteed to make a first-class light without the aid of counter-shafts or heavy flywheels. Self Oiling. Thoroughly Made. All parts accessible and interchangeable. Goes whenever called upon.

MARINETTE IRON WORKS MFG. CO.,
"G. F. WHEELER, General Sales Agent." MARINETTE, WIS.
CHICAGO OFFICE: 301 Fisher Building. Write for catalog and prices.

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

ELECTRIC LIGHTS AND FANS
FOR STEAM RAILWAY CARS

Electricity generated from Car Axle while car is in motion, and furnished from storage battery while car is stationary.



The "Axle Light" System is automatic in its operation. Each car carries its own lighting apparatus. Cost of maintenance insignificant.

GENERATOR APPLIED TO CAR TRUCK
A, Dynamo; B, Driving Pulley on Axle; C, Armature Pulley; D, Flexible Gearing; E, Tension Spring; FFFF, Hangers.

Consolidated Railway Electric Lighting and Equipment Company, 100 Broadway, New York

JNO. N. ABBOTT, Vice-President and General Manager.
JAMES L. TAYLOR, Third Vice-President.
JNO. T. DICKINSON, General Agent.
WRITE FOR ILLUSTRATED CATALOGUE.
J. L. WATSON, Secretary and Treasurer.

PANTHER HOLLOW BRIDGE AT SHENLEY PARK, PITTSBURGH, PA.

360 ft. Span. 40 ft. Roadway. Sidewalks, 10 ft. each.

Built and Erected for City of Pittsburgh by the

AMERICAN BRIDGE COMPANY

DESIGNERS AND BUILDERS OF

STEEL BRIDGES & **STEEL BUILDINGS**

AND ALL CLASSES OF

METALLIC STRUCTURES

GENERAL OFFICES: 100 BROADWAY, NEW YORK

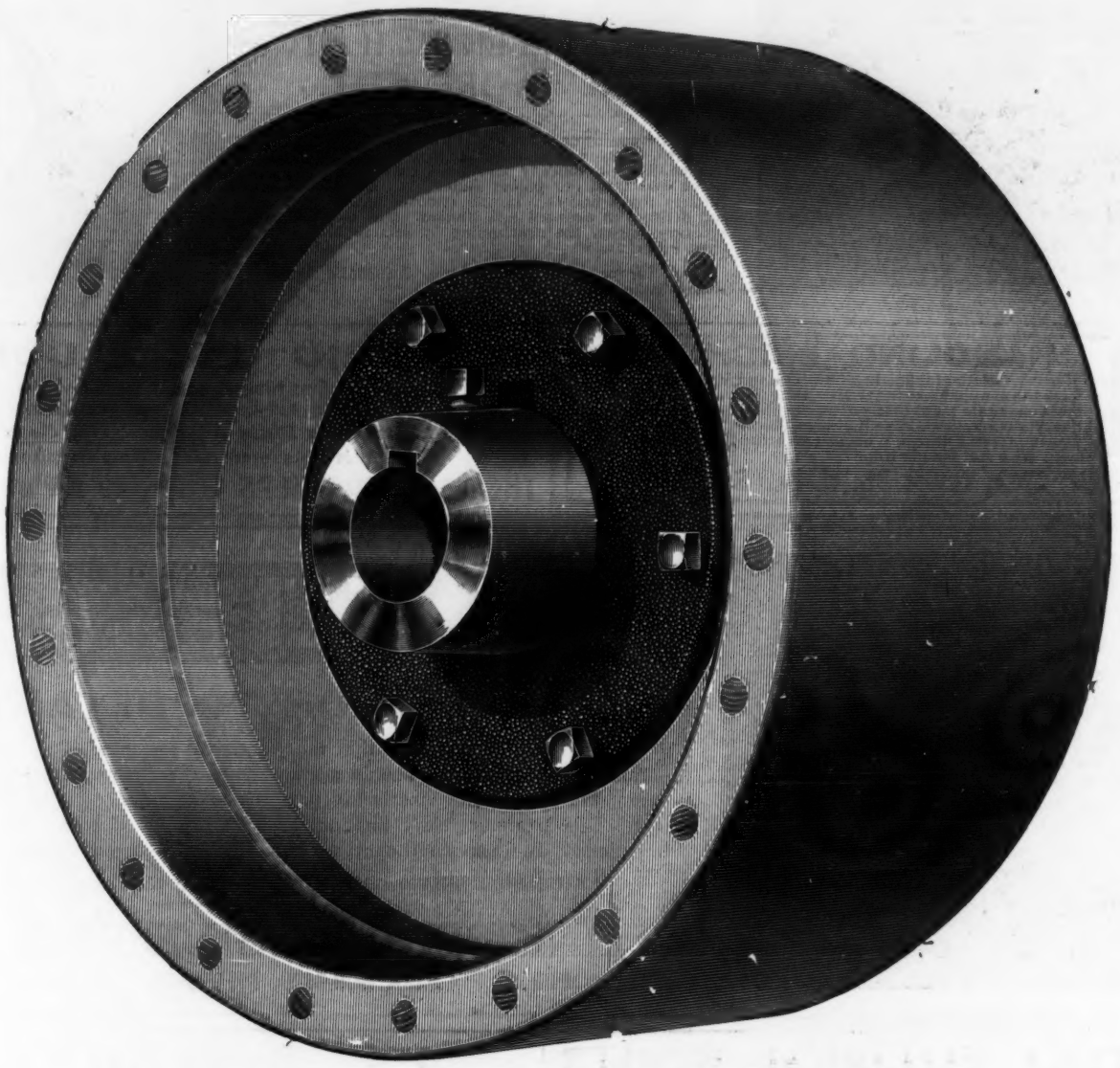
The facilities at our disposal and our operative system are such as to insure *most favorable quotations* and *deliveries for any part of the world.*

Branch Offices and Works:

Albany, N. Y. · Athens, Pa. · Boston, Mass. · Buffalo, N. Y. · Baltimore, Md. · Butte, Mont. · Columbus, Ohio. · Chicago, Ill. · Canton, Ohio. · Cleveland, Ohio. · Denver, Colo. · Duluth, Minn. · East Berlin, Conn. · Elmira, N. Y. · Groton, N. Y. · Horseheads, N. Y. · Lafayette, Ind. · Milwaukee, Wis. · Minneapolis, Minn. · New Orleans, La. · Pencoyd, Pa. · Philadelphia, Pa. · Pittsburg, Pa. · Rochester, N. Y. · Seattle, Wash. · San Francisco, Cal. · Salt Lake City, Utah · Sydney, N. S. W. · Trenton, N. J. · Wilmington, Del. · Youngstown, Ohio. · London, England.

LILLIBRIDGE, N.Y., 21-41

Each important feature of the
Rockwood Patent Compressed



Paper Pulleys

Has reached its highest development without any other being sacrificed.

Engineers and users should not fail to specify Rockwood's Patent Compressed Paper Pulleys on all orders and contracts.

Catalogue for the asking.

THE ROCKWOOD MANUFACTURING COMPANY,

Paper Pulley Sales Department, Indianapolis, Ind., U. S. A.

JOHN A. MEAD MFG. CO.,

Coal Handling Machinery,

11 GREENWICH ST.,
NEW YORK CITY.

Cut shows lower line of McCaslin Overlapping Gravity Bucket Conveyor installed at the new Power Station of the Milwaukee Electric Railway and Lighting Co. This conveyor receives coal from our patent Automatic Bucket, and delivers to bunkers above boilers. It also removes ashes as shown in cut, and delivers to elevated Ash Bunker. The conveyor is filled by ordinary chutes, the overlapping buckets requiring no Cumbersome Filler.

Send for catalog of Conveyors, Automatic Buckets, Cable Roads, Automatic Roads, etc., etc.

PATENT AUTOMATIC BUCKET.

COAL HANDLING MACHINERY

of many varieties for hoisting Coal, Ore and Stone from vessels, from the simple Mast and Gaff hoisting from canal boats to the most elaborate plant that will unload the largest vessel in one day; Automatic and Cable Railways, Coal Tubs, Steam Shovels, Mast and Gaff Fittings, Wheelbarrows and Hoisting Blocks for both Wire and Manila Rope.

C. W. HUNT CO, Taylor St., W. New Brighton, N. Y.

ELECTRIC CABLE CONVEYOR.

The first practical application of electricity to long-distance conveying machinery.

No Guy Lines. No Rigid Anchors. No Dead Weight to Carry.

It is worth investigating. Write for particulars to

THE W. F. BROTHERS CO., 43 DEY ST., NEW YORK, N. Y.

LINK-BELT ELEVATORS, CONVEYORS

ATTENTION TO DETAILS.

It is highly important that the wheels of Elevating, Conveying and Power-Transmitting Machinery should accurately fit the chains with which they are to run. All "Link-Belt" wheels are finished in the manner shown by accompanying cut. This treatment, very essential to the long life of both wheels and chain, is mentioned to illustrate the care given all details of our machinery.

"MODERN METHODS" CATALOGUE MAILED ON REQUEST.

LINK-BELT ENGINEERING CO.,

NICETOWN, PHILA. PARK BUILDING, PITTSBURG. 49 DEY ST., NEW YORK.

EVERY ELECTRICAL WORKER OR STUDENT : : : : :

Should have a copy of our book catalogue. It contains a descriptive list of nearly every electrical book published, and may be had for the asking.

ELECTRICAL WORLD AND ENGINEER,
120 Liberty Street, New York City.

PORTABLE CRANE AND HOIST.

FOR THE CONVENIENT AND QUICK HOISTING AND TRANSPORTING OF MACHINERY OF ANY SHAPE OR WEIGHT UP TO THREE TONS . . . . .

The handle is rigid in the axle, and when raised against the arms, the weight of the machine rests on the wheels and axle, forming a powerful and perfect brake. Write for circular.

The Franklin Portable Crane & Hoist Co.,
Franklin, Pa.

Agents:
Jos. Woodwell & Co., Pittsburg, Pa.
Strong, Carlisle & Hammond, Cleveland, O.
Selig Sonnenthal & Co., London, England.

....Dixon's Pure Flake Graphite....

is a Blessing to Every Engine Room and Machine Shop.

A small quantity added to any Oil or Grease largely increases its lubricating value and makes the finest Cooling Mixture.

Pamphlet and Sample Sent Free.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J.

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

THOROUGH INSPECTION. Insurance against Loss or Damage to property; also against Loss of Life and Injury to Persons, by Steam Boiler Explosions.

J. M. ALLEN, President.
W. B. FRANKLIN, Vice-President.
L. B. BRAINERD, Treasurer.
F. B. ALLEN, 2d Vice-President.
J. B. PIERCE, Secretary.
L. F. MIDDLEBROOK, Asst. Secy.

Principal Office, HARTFORD, CONN.

The U. S. Government

has adopted

Stephenson...
Bar Belt Dressing

for the big belts at the Watervliet Arsenal.

Result of testing Free Samples such as we would like to mail to *you*.

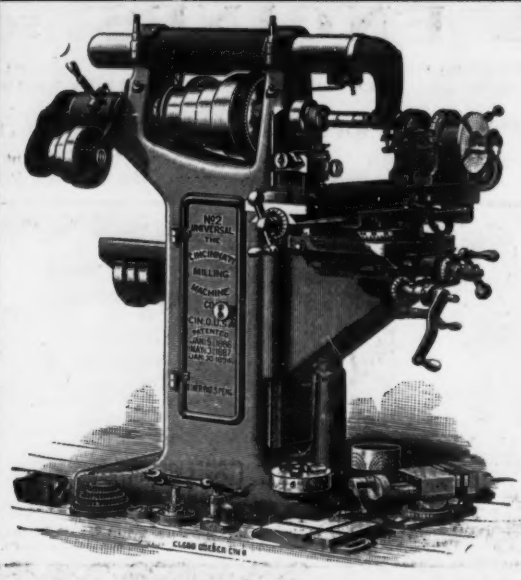
May we do so?

Stephenson Mfg. Co.,

Albany, N. Y., U. S. A.

WRITE FOR OUR CATALOGUE OF

ELECTRICAL BOOKS....



IF YOU

are milling pieces that are used in electric details requiring rapid changes from copper to brass or from iron to steel, you ought to be using

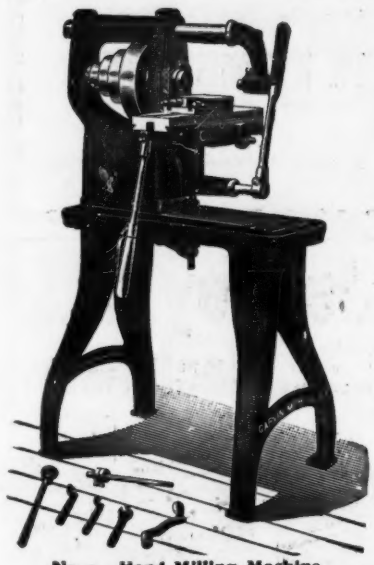
The Cincinnati MILLER

because it provides the exact facilities for doing just this class of work at a saving of time and money. That is what leading electrical manufacturers claim for "The Cincinnati." We should be glad to tell you more about it.

Write for our 1900 Catalogue D.

THE CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio, U.S.A.

European Agents—Schuchardt & Schütte, Berlin, Cologne, Vienna, St. Petersburg, Brussels, Stockholm and New York. Adolphe Janssens, Paris; Chas. Churchill & Co., London, Birmingham, Glasgow, Manchester and Newcastle-on-Tyne; The Niles Tool Works Co., 39 Victoria St., London, S. W. (1)



No. 2, Hand Milling Machine.

HAND MILLING MACHINES ..... Specially adapted for making light, quick cuts as required in the manufacture of Electrical Goods, Novelties and Brass Work.....

MANY VARIETIES AND SIZES OF MILLING MACHINES.

The Garvin Machine Co.

Spring and Varick Sts., New York.

New catalogue sent on request.

SALES AGENTS:

PHILADELPHIA: The Garvin Machine Co, 51 N. 7th Street.
CHICAGO: Manning, Maxwell & Moore, 22 S. Canal Street.
BERLIN: Deutsche Garvin Maschinen-Fabrik, Aktiengesellschaft, 17 Burg Strasse, Berlin C., Germany.
LONDON: C. W. Burton, Griffiths & Co., Ludgate Square, Ludgate Hill, London, E. C., England.
PARIS: Montgomery & Co., 28 Boulevard Magenta, Paris, France.

THE BURR STEEL SAFETY LIFT

is the only rope lock ever made which can be operated (in lowering the load) by one hand, thus leaving the other hand free to steady and place the load. It will work at any angle, the lock is positive even upon a wet or greasy rope, it does not cut the rope, it will do the work of a differential chain hoist, and is, of course, much more easily transported. Full description upon application.

THE BURR MANUFACTURING CO.,
131 VIADUCT, CLEVELAND, OHIO.

The Aultman Company,
CANTON, OHIO.
COAL AND ASHES
HANDLING MACHINERY.
SEND FOR CATALOGUE AND PRICES.
EASTERN OFFICE
718 FIDELITY BUILDING,
PHILADELPHIA PENNA.

IN WRITING TO ADVERTISERS Subscribers will confer a favor on us and also on the advertisers by mentioning that they saw the advertisement in ELECTRICAL WORLD AND ENGINEER.

Bullock Mining Machinery

Operated by

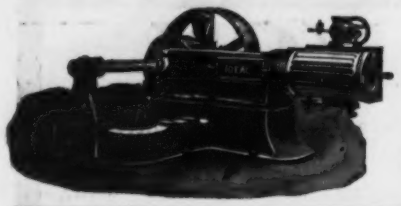
Electricity
Steam or Air.

DIAMOND POINTED PROSPECTING DRILLS,
ROCK DRILLS,
HOISTING ENGINES,
MINE VENTILATORS.

M. C. BULLOCK MFG. CO., Chicago, U.S.A.

REG. TRADE MARKS
Phosphor Bronze
DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED.
2200 WASHINGTON AVE. PHILADELPHIA
ELEPHANT BRAND PHOSPHOR BRONZE
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
—DELTA METAL—
CASTINGS, STAMPINGS AND FORGINGS
OF SPECIAL COMPOSITION.
SOLE MAKERS IN THE U. S.



IDEAL ENGINES. 50-1000 Horse Power.

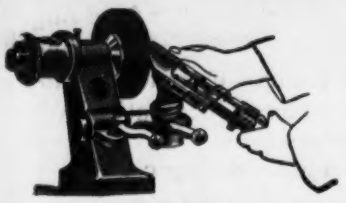
ALL TYPES, WHETHER SINGLE VALVE, FOUR-PORTED, SIMPLE OR COMPOUND, EMBODY OUR SELF-OILING SYSTEM, RECOGNIZED EVERYWHERE AS THE IDEAL METHOD OF LUBRICATION.

A. L. IDE & SONS, Principal Office and Shops, SPRINGFIELD, Illinois, U. S. A.

CHICAGO: 1203 Marquette Building. ST. PAUL: 209 Manhattan Building. ST. LOUIS: 316 Union Trust Building.
MINNEAPOLIS: 532 Guaranty Loan Building.

"The Best is the Cheapest"

THE WORCESTER
Drill Grinder



MADE BY
THE WASHBURN SHOPS
OF THE
Worcester Polytechnic Institute
WORCESTER, MASS.
The Largest Manufacturers of DRILL GRINDERS in the United States.

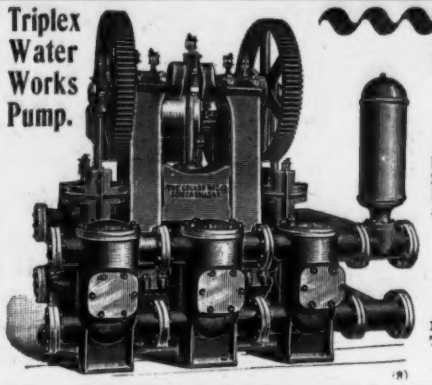
PRESSES, DIES AND OTHER
SHEET-METAL TOOLS
FERRACUTE MACHINE CO.
BRIDGETON, N.J. U.S.A.

ESTABLISHED A CENTURY AGO.
JESSOP'S STEEL
For TOOLS, DRILLS, DIES, etc.
All Kinds in Stock.
WM. JESSOP & SONS, Ltd.,
Chief American Office, 91 John St., N. Y.
Manufactory, SHEFFIELD, ENG.

THE JOHN H. McGOWAN COMPANY CINCINNATI OHIO
PUMPING MACHINERY
FOR EVERY SERVICE
SINGLE DUPLEX AND CRANK AND FLY WHEEL TYPES.

No Electrical Journal published has so large a foreign and domestic circulation as ELECTRICAL WORLD AND ENGINEER.

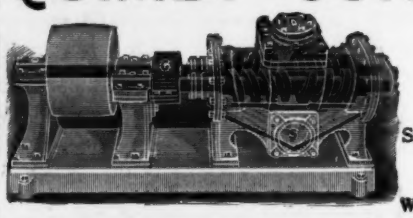
Triplex Water Works Pump.



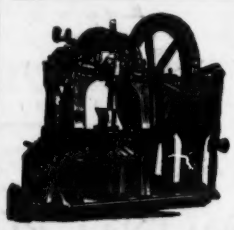
GOULDS EFFICIENT POWER PUMPS FOR EVERY SERVICE
The Standard of Excellence.
Improved Water-Works Pumps, Mining, Sewage and Railroad Tank Pumps, Boiler Feed and Tank Pumps, Irrigation Pumps, arranged for any driving power.
Send for Catalog.
THE GOULDS MFG. CO.,
Works and Main Offices,
Seneca Falls, N. Y.
16 Murray St., New York. 8 Oliver St., Boston.
The Gould Co., 22 and 24 N. Canal St., Chicago.

Davidson Pumps.
Surface and Jet Condensers.
MOST ECONOMICAL AND DURABLE.
WORKMANSHIP AND MATERIAL OF THE BEST.
M. T. DAVIDSON,
133 LIBERTY ST. NEW YORK.

QUIMBY SCREW PUMPS.

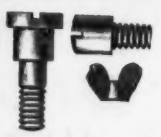


NO VALVES, NO PACKING, NO PULSATION.
....SEND FOR CATALOGUE...
Direct Connected Electric Pumps. Simple in construction, have few parts, and are very efficient.
WILLIAM E. QUIMBY, Inc.,
Washington Life Building, 86 Liberty St., N. Y.

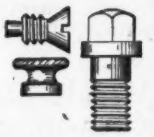


WHY NOT KNOW
How Much Steam Your Condenser will Consume?
DUTY GUARANTEED
CONOVER CONDENSERS
The Conover Mfg. Co., 26 Cortlandt St., New York (1)

PHILADELPHIA MACHINE SCREW WORKS.



624 and 626 Race St., PHILA., PA.



MANUFACTURERS OF
All kinds of Special Machine Screws and Studs.
Thumb Screws and Nuts, Bicycle and Electrical Works.

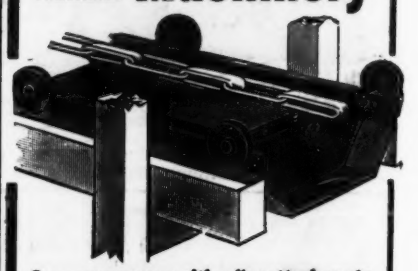
STEEL TUBE, BRASS TUBE, COPPER TUBE, ALUMINUM TUBE, PLATINUM TUBE.
Seamless Tubing
IN ALL METALS.
From 2 inches in diameter, to size of a human hair

Anything in Metal Tubing
HOLLOW WIRE.
ELLWOOD IVINS,
MANUFACTURER.
MILL, OAK LANE, PHILADELPHIA, PA.
487 BROADWAY, - NEW YORK.

"Boch Glaze Filled"
Patented March 8 and 22, 1898.

The name of the best **High Voltage Porcelain Insulator** made.
Ask for particulars and tests.
Manufactured exclusively by
THE R. THOMAS & SONS CO.,
EAST LIVERPOOL, OHIO.
Sales Office:
39 and 41 Cortlandt Street, NEW YORK.

Jeffrey Elevating Conveying Machinery
Designed to suit all Conditions



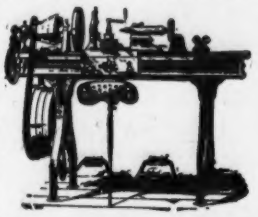
Scraper conveyor with roller attachments
We manufacture Elevators, Conveyors, Chains, Standard and Special, Sprocket Wheels, Elevator Buckets, Boots, Bolts, Shaking and Revolving Screens, Coal and Coke Crushers, Cable Conveyors, Spiral Conveyors, Rubber Belt Conveyors, Coal Washers, Bolting Screens, Dredges, Dump and Skip Cars, Hoists, Coal Mining Machines, Electric Mine Locomotives, Dynamos, Generators, Pumps, Etc., Etc.
Investigation Pays Whether You Purchase or Not. Send for our Catalogues. Address
THE JEFFREY MFG. CO.
COLUMBUS, O., U.S.A.
NEW YORK, 41 DEY ST.

AN INTENDING PURCHASER

of electrical apparatus anywhere always consults this paper's advertising pages to ascertain who makes what he wants. ELECTRICAL WORLD AND ENGINEER is recognized in every country of the world as the leading electrical journal.

Horizontal Internal Self-Oiling Engines, 25 to 600 H. P.
Horizontal Medium Speed Engines, 300 to 800 H. P.
Vertical Compound Engines, 100 to 800 H. P.

THE BALL ENGINE CO., ERIE, PENNSYLVANIA.



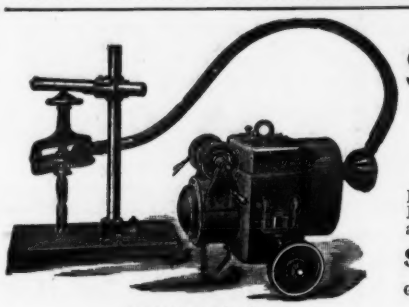
Screw Cutting Lathes,
from 9-inch to 13-inch swing.
Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle.
SEND FOR CATALOGUE.

Barnes' Upright Drills

8-inch to 42-inch Swing.

SEND FOR CATALOGUE.

W. F. & John Barnes Co.
216 Ruby St., Rockford, Ill.



Established 1875.

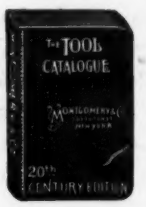
COMBINATION OF
STOW FLEXIBLE SHAFT
AND
Iron Multi-Speed Motor.

Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and prices.

STOW MFG. CO., Binghamton, N. Y.

General European Agents, SELIG, SONNENTHAL & CO., 85 Queen Victoria Street, London, England.
SEE STATIONARY MOTORS IN NEXT ISSUE.

Facts About Factory Tools



Anything and everything you want to know about factory tools or any other tools will be found fully explained in the new and enlarged edition of

MONTGOMERY & CO.'S TOOL CATALOGUE

Thoroughly up to date, with hundreds of new pictures and lucid descriptions of tools for all purposes. A book for study and reference, chock-full of useful and technical information. Everybody should have it. By mail for 25 cents. (5)

MONTGOMERY & CO., 105 Fulton St., New York City.

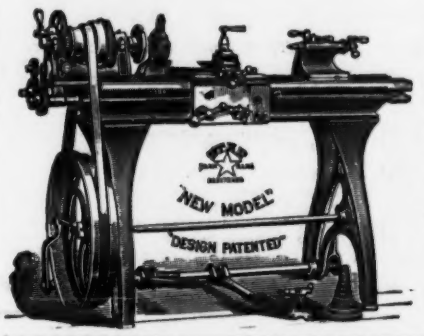
If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

Electricians—Draftsmen—Engineers

Send for a Catalogue of our
ADJUSTABLE DRAFTING TABLES
3 STYLES. 7 SIZES. PRICES RIGHT.
They are the best in the world.

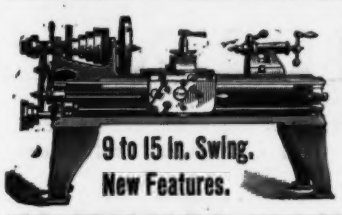
J. S. ALEXANDER MFG. CO.
28 COURT STREET,
GRAND RAPIDS, MICH., U. S. A.

STAR LATHES "DON'T COME BACK."

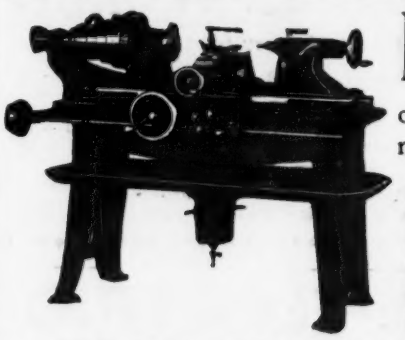


Always give satisfaction even to the most discriminating buyer. They are complete screw-cutting engine lathes with automatic cross feed with either plain or compound rest, U. S. Standard, Whitworth or Metric lead screws, foot power or countershaft, 9 and 11 inch swing. Suitable for electrical and bicycle works, tool makers, gunsmiths, technical schools and fine accurate machine shop service. Send for Catalog B.

SENECA FALLS MFG. CO.,
422 WATER ST.,
SENECA FALLS N. Y., - - U. S. A.



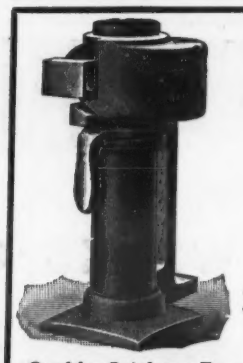
SEBASTIAN LATHES CATALOGUE FREE.
Sizes, 9, 10, 13, 15 ins.
ARE GOOD LATHES.
SEBASTIAN LATHE CO.,
121-123 CULVERT ST., CINCINNATI, O.



IF you are not familiar with our line get our catalogue. There are machines in it you could save money by using.

Hand Lathes, Milling Machines, Upright Drills, Positive Taper Stud and Bolt Lathes, Automatic Worm-wheel Cutting Machines, and Heavy Turret Chucking and Turning Machines.

THE GRANT TOOL COMPANY, Cleveland, Ohio. (2)



THIS is a 7-ton, Swivel Claw Hydraulic Jack; it is small, light and portable; operates either horizontally or vertically.
We make the most complete line in the world of

Hydraulic Presses and Jacks
VALVES, FITTINGS, DIES, Etc.
WATSON-STILLMAN CO.
204, 206, 208, 210 East 43d St. NEW YORK, N. Y.
Branch Office: 450 Rookery, Chicago, Ill.
Send for Catalogue F. HIGH PRESSURE HYDRAULIC WORK (3)

To meet the growing demand for a motorette of greater seating capacity than our standard New York type, we have designed and are ready to take orders for

OUR SURREY

This surrey is easy to operate and of graceful appearance.
It is fitted with a powerful motor, and it can climb hills.

We are the Sole UNITED STATES AGENTS and LICENSED MANUFACTURERS for

Messrs. De Dion-Bouton & Co., of France.

Send for our complimentary booklet of information for prospective purchasers.

DE DION-BOUTON MOTORETTE CO.,

Church Lane and 37th St., Brooklyn, N. Y.

Branches in the following cities:
NEW YORK, 57 West Sixty-sixth Street.
PHILADELPHIA, 306 North Broad Street.
PITTSBURG, Highland & Centre Aves.
WORCESTER, Mass., 24 Washington Square.
BOSTON, Mass., 33 Stanhope Street.
PROVIDENCE, R. I., 196 West Exchange Street.

Columbia Electric and Gasolene . .

AUTOMOBILES

Now in the Sixth Year of Service.

Mark XIX. Columbia Surrey

With a Columbia Automobile, your service and convenience are at the grasp of a lever or the turn of a crank with an assurance of safety, reliability and speed the perfection of mechanical parts alone can give,

ELECTRIC VEHICLE CO.

Hartford, Connecticut. CATALOGUE ON REQUEST New York Ofice, 100 Broadway.

AN INDEX

TO

Electrical Technical Periodical Literature of the world for fourteen years, including all original articles and all "Digest" references published in

THE ELECTRICAL WORLD

From January 1st, 1883, to January 1st, 1897.

Cloth. 372 Pages. Price, $8.00.

Copies of this or any other electrical book published will be sent by mail, POSTAGE PREPAID, to any address in the world on receipt of price.

ELECTRICAL WORLD AND ENGINEER, Publishers,
120 Liberty Street, New York.

The HEWITT-LINDSTROM Electric Vehicles

Have a perfect motor suspension and a flexible running gear, giving them the most flexible perch of any vehicle on the market.

They cannot get out of order, being of the most perfect mechanical construction and being especially designed to avoid burning out motors or injuring the batteries.

WATCH OUR NEXT ISSUE. (1)

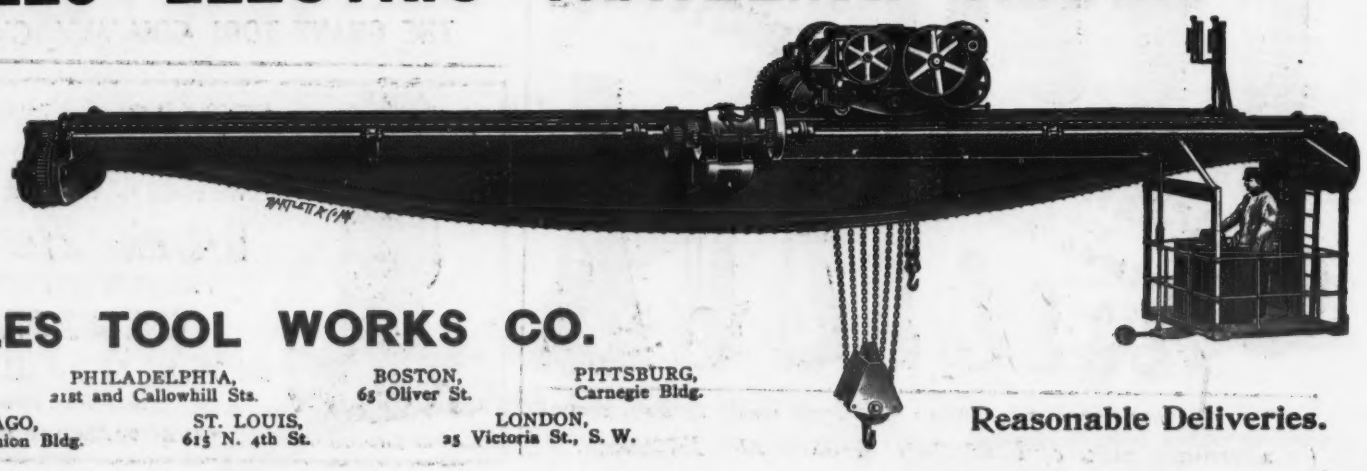
HEWITT-LINDSTROM MOTOR CO.,

75 North Clinton Street, - - - CHICAGO. ILL.. U. S. A.

NILES' ELECTRIC TRAVELING CRANES

Built on Latest and Improved Designs.

For Full Information and Specifications Apply to

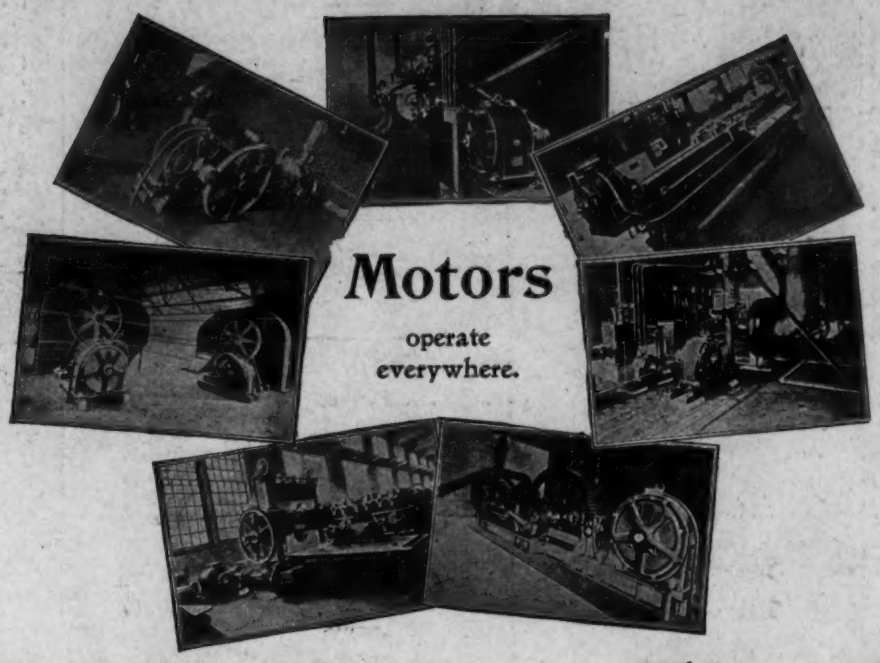


NILES TOOL WORKS CO.

NEW YORK, 136-138 Liberty St. PHILADELPHIA, 21st and Callowhill Sts. BOSTON, 65 Oliver St. PITTSBURG, Carnegie Bldg.
CHICAGO, Western Union Bldg. ST. LOUIS, 615 N. 4th St. LONDON, 25 Victoria St., S. W.

Reasonable Deliveries.

Westinghouse



Westinghouse Electric

& Manufacturing Co., Pittsburg, Pa.

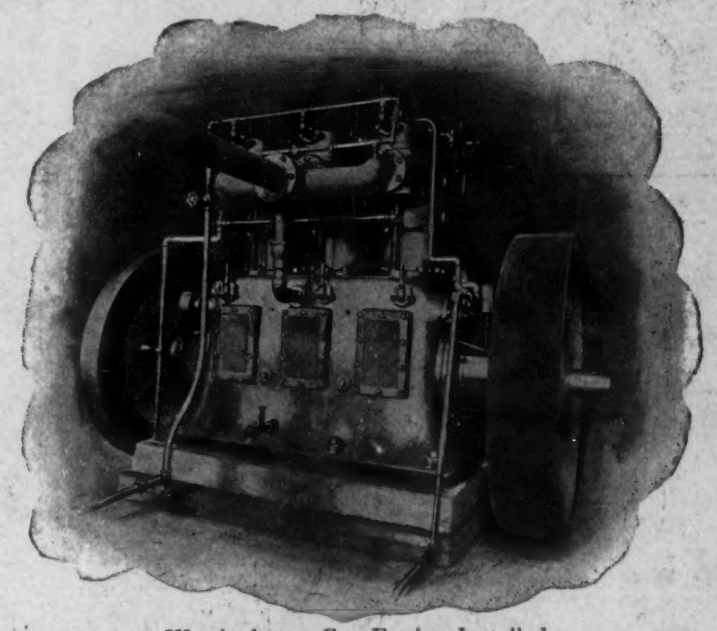
All principal cities in U. S. and Canada.

Westinghouse

Gas & Steam Engines

Gas Engines, perfectly adapted to the requirements of electric lighting.

Steam Engines, compound and non-compound, built in sizes up to 8000 H. P.



Westinghouse Gas Engine Installed.

Westinghouse, Church, Kerr & Co.

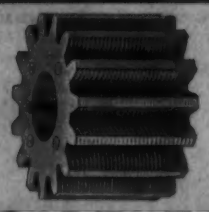
New York, Philadelphia, Boston—ENGINEERS—Pittsburg, Detroit, Chicago.

Sell the Product of **The Westinghouse Machine Co.**

Pittsburg—Manufacturers—Chicago.

Write nearest office of Westinghouse, Church, Kerr & Co.

27 z



NOISELESS GEARS,

SPUR, BEVEL, AND FRICTION.

We also make

METAL GEARS.

THE

NEW PROCESS RAW HIDE CO.

Patentees and Sole Manufacturers.

SYRACUSE, N. Y., U. S. A.

INCANDESCENT LAMPS COLORED WITH VITRO CHROME

look like natural glass. The colors produced are bright and durable, and can be used for indoor and outdoor decorations; also used for **Railway and Steamboat Signal Lights, Electric Signs, Etc.** Vitro Chrome is superior to any other incandescent lamp color. A trial will convince you. Manufactured only by

Send for Circular.
For Sale by all Dealers and Electric Supply Houses.

VITRO CHROME CHEMICAL CO.,
421 Milwaukee St., MILWAUKEE, WIS.

MODELS AND EXPERIMENTAL WORK.

Inventions Developed and all class of Special Work.

E. V. BAILLARD, FOX BUILDING, FRANKLIN SQUARE, NEW YORK CITY.

SEARCH LIGHTS.

RUSHMORE PROJECTORS are in almost exclusive use in all classes of service, and are specified for finest Steamers and Yachts.

RUSHMORE DYNAMO WORKS,

Telephone 559. Jersey City.

CONDENSERS.

William Marshall, Manufacturer of Electric Condensers. Standards a specialty. 709 Lexington Ave., near 57th St., N. Y. City.

PARSELL & WEED

MODEL MAKERS

Electrical Experimental and Fine Tool Work.

Write for Booklet.

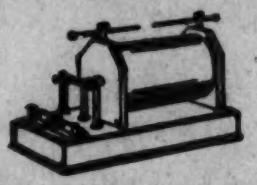
The Franklin Gas Engine Sets of Castings and Material; Finished Parts and Complete Engines. Write for Gas Engine Circular No. 1.

Telephone 156 Madison Square.

The Franklin Model Shop, 129-131 W. 31st St., New York.

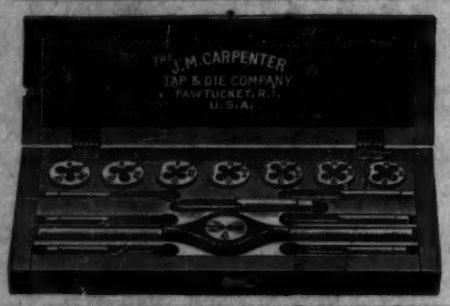
The Ritchie Induction Coil

FOR X-RAY WORK



Send for prices and information; catalogue of fine electrical and scientific instruments free.

E. S. RITCHIE & SONS, BROOKLINE, MASS



Manufacturers of

TAPS, DIES,

and all kinds of

TOOLS FOR CUTTING **SCREW THREADS**

Our illustrated catalogue of 112 pages sent free on application.

TRADE OUR MARK

Is stamped on all goods of our make.

WESTON Electrical Instrument Co.,

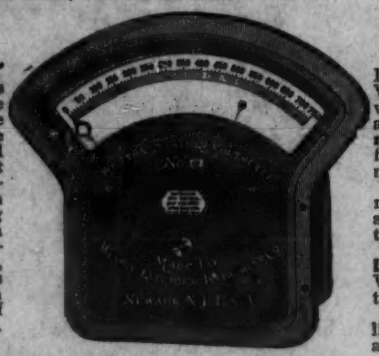
114-120 William St. Newark, N. J., U. S. A.

BERLIN: European Weston Electrical Instrument Co., No. 88 Ritterstrasse.
LONDON: Elliott Bros., No. 101 St. Martin's Lane.

Illuminated Dial Station Instruments.

These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof, cast-iron case, which effectively shields the instruments from disturbing influences of external magnetic fields.

(9)



Weston Standard

Portable Direct Reading Voltmeters and Millivoltmeters, Ammeters and Milammeters, **Wattmeters,** and **Voltmeters,** for **Alternating** and Direct Current Circuits.

Our portable instruments are recognized as standards throughout the civilized world.

Our **Semi-Portable Laboratory Standard** Voltmeters and Ammeters are still better.

They are the most reliable, absolute standards for Laboratory use.

Weston Standard Illuminated Dial Station Voltmeter, Style B, "Flush Type."

Mention ELECTRICAL WORLD AND ENGINEER when writing for catalogues

The Storage Battery Supply Company

WE MAKE, RENT, RECHARGE, REPAIR STORAGE BATTERIES.

YACHT LIGHTING. CARRIAGE LIGHTING. ELECTRICAL DECORATIONS.

289 East 27th Street, New York.

HOLOPHANE GLASS CO.

No. 15 East 32d St., New York.

MANUFACTURERS OF

Compound Prisms Globes and Shades

FOR ALL KINDS OF LIGHTS

GUARANTEED TO GIVE

"Maximum Light, Perfect Diffusion, Minimum Glare"

SEND FOR CATALOGUES AND PRICE LISTS

(2)

FIBRE FOR INSULATION AND MECHANICAL PURPOSES.
SHEETS AND FINISHED SHAPES OF ALL KINDS.
DELAWARE HARD FIBRE COMPANY, WILMINGTON, DEL.